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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

Institute of British Foundrymen.

FEBRUARY 28.

London Branch (Junior Section):—Ordinary meeting at 49, Wellington Street, London. "Modern Cupola Practice," Paper by H. W. Keeble.

MARCH 1.

Lancashire Branch:—Ordinary meeting at Manchester. "The Foundry is a Machine," Paper by Geo. E. France.

Wales and Monmouth Branch:—Ordinary meeting at Bristol. "Some Interesting Moulding Jobs," Paper by E. Longden.

East Midlands Branch:—Annual dinner at Loughborough.

West Riding of Yorkshire Branch:—Ordinary meeting at Bradford. "High Quality of Cast Iron for Steam, Diesel and Compressor Cylinders," Paper by F. J. Cook.

The New Educational Scheme.—III.

We have discussed at some length the new proposals with regard to foundry education, covering both the craft and the technical aspect of the situation. It remains to consider what state of affairs might reasonably be anticipated once these proposals have become established in practice. It is, of course, essential to remember that in the case of the craft scheme the employer has an even more important part to play than the education authorities, since it is for him to provide a definite craft training. If, however, this be provided in conjunction with a scheme that offers the apprentice a definite objective, then several desirable results may reasonably be anticipated. The number of boys entering the trade would increase and their quality would improve, for these results have never failed to follow the introduction of a satisfactory scheme of trade training in any industry. Further, the provision of a professional certificate would stimulate the apprentices to do their best, so that the more ambitious and capable among them would undoubtedly work for this higher certificate and so in the course of time provide natural candidates for the higher executive posts. In the meantime the present executives will undoubtedly be called upon to act as examiners, judges of practical skill, and teachers in technical school courses, so that they have an unexampled opportunity of influencing the new generation.

Supposing the scheme to be satisfactorily established, what relationship will it bear to the possible creation of a foundry high school or technical school? It will, of course, be open to employers to send foundry apprentices—as many engineering apprentices are sent already—to the technical school for one full day's study per week for the National Certificate course. This postulates a school sufficiently supplied with equipment, accommodation and staff to undertake technical certificate courses and craft apprentice classes in the evening, and it would inevitably follow that such a school would soon be in a position to conduct full-time day courses for those of proper previous experience. It may well be left for the future to determine how far this is likely to arise, and if it does arise how far any one such school is likely to establish an ascendancy over the rest in respect of staff, size, equipment, accommodation, etc. Obviously there are only about six or eight well-recognised foundry centres in which such a school could arise at all, and its development would necessarily depend on the importance of the industry in the area and the support and interest of local employers. It is, however, unlikely that any school would establish an ascendancy over any other without some marked geographical advantage. While it is to be hoped and expected that some such development will take place in the future it must, however, be remembered that for the moment the interest of founders is more likely to be concentrated on the working of the new educational scheme on its simplest basis. It is doubtful, however, if there would be enough students to supply more than one school of the highest type, giving a full-time day course in foundry education.

Recognition.

After more than 10 years of propaganda in this column we are naturally pleased to see that at long last recognition is being accorded to the basic importance of the foundry industry. Some little time ago we made a series of calculations of the annual buying-capacity of the British foundry industry, and arrived at the impressive figure of £26,000,000. Many with whom we have spoken consider this to be an extremely conservative estimate. It was stated last Thursday, at a joint meeting of the two welding associations and the London Branch Institute of British Foundrymen, that the welding trade, through its repair activities and not by its welded-fabricated material, robbed the foundry industry of £1,000,000's worth of orders a year.

Then, again, the figure derived from a study of the official Guide Book, published by the Birmingham Section of the British Industries Fair, shows that from 25 to 30 per cent. of the exhibitors are foundry owners, whilst Mr. H. B. Weeks, the chairman of the British Cast Iron Research Association, has publicly stated that 90 per cent. of the exhibits employ cast products during their fabrication. Unquestionably, the foundry owners themselves now recognise the importance of their industry, but the general public still imagines, to be part and parcel of something equally nebulous and normally designated as the "great engineering industries." This week we publish a number of speeches made at the various provincial dinners of the Branches of the Institute of British Foundrymen, and we find in general an inadequately clear-cut recognition of the foundry as a separate entity. In Sheffield it becomes entangled with the steel industry; in Manchester with textile engineering, and on the North-East Coast with shipbuilding. This "departmental" aspect is one which every foundryman should aim to minimise, whilst boosting the foundry as an independent economic unit. It is an ideal well worth striving after. If a mental attitude can only be created which regards the foundry trade as an economic whole and not as a series of departments of every other industry, it will induce conditions definitely favourable to the amelioration of every phase of its multitudinous activities.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

The Brackelsberg Rotary Furnace.

To the Editor of The Foundry Trade Journal.

Sir,—An article "Melting Iron in the Rotary Furnace," by Mr. Ch. Bouvard, which appeared in a recent number of your journal, describes a new melting process which has been developed in Germany, and which, on account of its surprising heat and metallurgical advantages, has been largely adopted.

This article is misleading, inasmuch as it does not mention that it refers to the Brackelsberg furnace, which has been described in your journal on various occasions, and the patents for which are owned by Mr. Carl Brackelsberg, of Milspe, Westphalia.

It is true that the furnace described is but a crude and unauthorised copy of the Brackelsberg furnace, but, in justice to the firm which built it, we would say that they have since recognised the Brackelsberg patents and have taken a licence under the same.

It is important that this should be mentioned, because the furnace referred to differs very strongly in essential parts from the method of construction approved by the inventor, and the results attained were far below those which can be secured by the Brackelsberg furnace of to-day, although the article in question uses some of the data that was secured by Dr. P. Bardenheuer in his early tests of the Brackelsberg process.

In view of the wide interest that is now taken in this method of melting iron, we are sure you will appreciate the fact that it is important to give your readers the benefit of the above information, particularly as the process is now applicable not only to iron but also to steel castings which have unusual qualities.

Were it not for the fact that the article in question has caused a certain amount of misapprehension amongst our prospective licensees, we would not have attempted to trespass on your space, but we feel sure that you will recognise the fact that the article, so closely describing our type of furnace and giving results so much less favourable than those we have actually attained in everyday practice, cannot be allowed to pass unnoticed, for while we give every facility to English ironfounders to see the process in actual operation, there are many who, having read the article, have formed erroneous ideas; and we know how widespread is the circulation of your journal from the fact that the articles you have published have brought us inquiries from all parts of the world.—Yours, etc.,

J. D. Brackelsberg,
By Charles F. Lumb.

Malaya House,
Admiralty Arch, S.W.1.

A New Runner Bush Machine.

Messrs. Beecroft & Partners, Limited. of Retort Works, Mappin Street, Sheffield, have designed and placed upon the market the "Presto" runner bush machine. It consists of a simple lever mechanism mounted upon a suitable bench. The lever is counterbalanced and is mounted on a vertical member which, by means of two arms, one above the other, carries a vertical shaft. This shaft terminates in a pattern for the bush, and is raised and lowered by the lever. An output of 300 runner bushes per hour is claimed. The machine is designed to take any size up to 12 in. dia. by 5 in. deep, whilst the standard size of bush is 4½ by 3½ by 2½ in. deep.

Newark Foundrymen Meet.

A meeting of Newark's foundrymen and engineers was held last week, when Mr. W. C. Freeman, of Birmingham, gave a lecture, illustrated by lantern slides, on "Modern Welding Systems and Applications." The slides shown were in themselves an education, and depicted many spectacular cutting and welding operations. In the "running commentary," the lecturer displayed an intimate knowledge of his subject. Mr. Freeman explained that inside information which is so valuable, both to the operative welder and to the general engineer. Among the electric-welding machines was one which cut holes in mild-steel plates automatically, the hole being perfectly smooth and of the exact size and shape of the pattern. Another new accomplishment, explained in detail, was the welding of brass castings—popularly believed to be impossible.

Messrs. Menmuir, Palmer, Lane and Bedford, who contributed to the discussion, complimented Mr. Freeman and his assistant, Mr. Parkinson, upon their interesting lecture and accorded them a hearty vote of thanks.

Institute of Metals.

Change of Venue for Annual Dinner.

Owing to the large number of acceptances for the Institute's Annual Dinner and Dance, to be held on Wednesday, March 12, at 6.45 p.m., it has been found necessary to *change the venue* from the Hoted Victoria to *the adjoining Hotel Metropole*, where even better accommodation is available, the dinner being held in one large room and the dance in another (the old Midnight Follies ballroom). The new accommodation being ample, it is possible to issue additional tickets (price £1 each) if applied for promptly to the Secretary, Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, London, S.W.1.

Coke Research.

In a lecture, given to the West of Scotland Iron and Steel Institute in the Royal Technical College, Glasgow, on February 21, Dr. Sinnatt gave a summary of work which is being carried out in the fuel research station at East Greenwich upon the characteristics of coke. The object of this work is to ascertain the reasons why certain types of coke are superior to others for use in cupolas, blast furnaces, domestic grates, etc. In general, he was able to confirm the work carried out by the late Sir George Beilby. With the aid of a series of lantern slides, Dr. Sinnatt showed the structure of coke, which, in the main, was formed from a mass of bubbles, each bubble having a window-like formation. He further explained the relationship existing between the structure of cenospheres and of lump coke. Laboratory tests carried out to determine various properties of coke had not yet been completely confirmed industrially, but valuable data had been obtained. He stated that there appeared to be indications that the characteristics of a coke were largely determined by the iron which was present in the inorganic constituents.

Imported Refractory Bricks.

The Standing Committee under the Merchandise Marks Act recommends that tiles and refractory bricks shall bear an indication of origin at the time of importation as well as of sale.

Mr. John Shepherd, of Jarrow, a workman employed at the blast furnaces of Messrs. Palmers Shipbuilding & Iron Company, Limited, Jarrow, has been awarded by the King the Edward Medal for his gallantry in attempting to save the life of Hugh Black, a fellow workman, in October last, when fatally gassed.

Random Shots.

At the time of writing I have not yet visited the British Industries Fair, so that I must express hopes rather than state facts where it is concerned. And the chief of these—I fear a vain one—is that a little more sense of proportion than usual may govern the published accounts of its marvels, whether displayed at Castle Bromwich or at Olympia. As a rule every newspaper in the land devotes a certain amount of space to the subject, and some of them devote a great deal of space to it, but I venture to question how much of the space so devoted serves any purpose whatsoever beyond the primary one of tickling the readers' palate. Now the Powers That Be in the world of newspapers may retort that this primary purpose of tickling the reader's palate is the only thing that concerns them, and up to a point they are perfectly right. Certainly they are right in the case of the popular picture papers, which, if I am to judge by my own not inconsiderable experience in suburban railway carriages, are read almost exclusively by female clerks and shorthand typists. And with all due respect to the species, female clerks and shorthand typists doubtless do demand that their favourite papers give pride of place to a new form of shopping-bag or a lifelike wax model admired by a member of the Royal Family.

* * *

But there are other papers, and I venture to suggest that on an occasion of such immense national significance as the British Industries Fair these other papers have a certain duty to perform beyond that which is discharged by the mere process of tickling the reader's palate. At the moment the ingenious gadget is glorified at the expense of the solid achievement, partly, no doubt, because the nice young men sent to "cover" the Fair lack the technical knowledge necessary for the full appreciation of the solid achievement, and lack also the technical language necessary for writing it up. Partly, too, the adventitious aids of smart showmanship, striking display, etc., are more likely to be enlisted on behalf of the gadget. And in so far as the Press caters—or should cater—for industry as well as for the rest of the community, and since the prosperity of the rest of the community and so of the Press depends on the prosperity of industry, it is surely not too much to ask that some attempt be made to separate the wheat from the chaff, or perhaps it would be better to say the mammoth from the mouse?

* * *

The other day I encountered a selection from the wise-cracks of Kin Hubbard, an American master of that art. I don't know enough about the States to tell you in what esteem this gentleman is held in his own country, but some of the examples struck me as too good to waste. I reproduce them in all their original glory, believing in this era of talkies and such monstrosities no interpreter will be necessary:—

"Talk like you're sending a telegram an' you won't make your friends so tired."

"After a girl pencils her eyebrows these days she's half dressed."

"Our idee of a mollycoddle is a feller that lets his wife pick out his stenographer."

"Th' worst waste o' breath, next t' playin' a saxophone, is advisin' a son."

"Next to battleships ther' hain't nothin' gits out o' date as quick as bridegrooms."

Marksman.

Scottish Foundry Developments.

DECLINE OF PIPE FOUNDING.

At a meeting of the Scottish Branch of the Institute of British Foundrymen held in Glasgow on January 18, 1930, MR. P. MACFARLANE, foundry manager of Messrs. Shaw, Glasgow, Limited, read a Paper on "Fifty Years of Practical Foundry Life." Mr. J. Longden, Past-President, was in the chair.

When asked to describe the progress of ironfounding during the period which he has been connected with the industry, which is not quite fifty years, the author at first hesitated. Naturally it must be from the point of view of the ironmoulder and may therefore appear prejudiced in his favour. The progress of the industry involves the labours of many others who do not actually work in the foundry, as before the casting is moulded it must be designed, the pattern has to be prepared and the composition of the metal must be determined. The casting has afterwards to be dressed and machined. Thus an advance in knowledge may be contributed by the draughtsman, the patternmaker, the chemist and the engineer, apart altogether from the moulder.

The author naturally feels very strongly about the status and morale of the moulder. The foundry was for a long time shunned and slighted not only by outsiders but by the moulders themselves. Among other reasons this was due to the work being considered dirty, strenuous and hot. These are certainly obvious disadvantages of the trade, but nevertheless moulding is a noble art and worthy of the best boys who can be brought into it.

The following incident, which made a deep impression on his mind at the time, will illustrate the general attitude towards the moulder in those days. About 40 years ago a foundry foreman superintended the making of a large casting which at the time was regarded as a masterpiece of the art. After its completion a luncheon was given in honour of the achievement, to which those who had taken part in the production of that casting—draughtsman, patternmaker and engineer—were invited, but the moulder was omitted. One can imagine the feelings of that man, who had taken a great pride in applying his knowledge and skill to the production of the casting. Fortunately the foundry now receives the credit which it deserves, and the status of the moulder is as high as that of any other tradesman.

A young man may now study moulding and allied subjects at a technical school, and it is pleasing to note that the Institute has a committee at work organising the training of apprentices and the granting of certificates of proficiency in foundry craft.

In the old days the attendance of a boy at evening classes was a great hardship, as he had to start work at 6 a.m. and continue until 6 p.m., with two breaks for meals. The apprentice of to-day has in comparison many advantages. He has a shorter working day and much more healthy places in which to work, and, moreover, there are welfare schemes. He is thus given the time and *should* have the inclination to study at evening classes the subjects appropriate to his work. The classes which should be attended by the apprentice moulder are: Higher arithmetic, mathematics, drawing (free-hand, geometrical and model), practical plane and solid geometry, machine construction and drawing, the grading of iron by fracture and analysis. The apprentice should have some laboratory instruction and study the relationships of carbon, silicon, manganese, sulphur, and phosphorus in the different grades of iron.

Fifty or sixty years ago an apprentice moulder was indentured or bound, and the penalty for breaking the indenture was imprisonment, after serving the sentence the boy was compelled to finish his indentured time at the foundry. The wages paid were very small, but even if the lad had an opportunity of more lucrative employment it was against the law to leave the foundry. A personal acquaintance was imprisoned for breaking his bond, and had a very hard struggle when he returned to the foundry. However, he is now retired and enjoying the evening of his days in comfort.

At the present time there is a foreman in some foundries to train the boys and also a school which the lads attend in working hours. At the age of 21 the boy becomes a journeyman, there is no rigid seven years' apprenticeship now. In the old days a man had to be voted by the men in the shop to be a skilled moulder fit to perform a day's work worthy of a man. This was a certificate worth having.

It is proposed to divide this Paper into four parts namely, the cupola in the foundry, the jobbing foundry, the vertically-cast pipe foundry and the light-casting foundry.

The Cupola in the Foundry.

The efficient cupola is that which has the lowest consumption of fuel per ton of iron melted. There first must be a good fan or blower, with an outlet suitable for the volume and pressure of blast required, as close to the cupola as possible. To eliminate the bad habit of guessing, suitable volume- and pressure-gauges are very useful in registering the condition of the tuyeres. The blast-belt is divided in two for the purpose of clearing the tuyeres if they should get blocked, and, consequently, the volume of air decreased. Two inlets are necessary for this purpose, with valve on each to control the air supply. This method of clearing the tuyeres must be performed very carefully. Another method is to use an iron bar, and it is advised that this be done as seldom as possible, as it induces a drip of iron to come into the tuyere and ultimately choke it altogether.

The next point about the efficient cupola is not to have too deep a well or bottom, as it depends on this dimension for the amount of coke to fill it up. It is thought that 18 in. below the bottom row of tuyeres sufficient for this purpose, and at the very most 12 cwts. of coke to fill up the bed before charging, to suit a daily melt of 60 to 70 tons. Two rows of tuyeres are advisable, associated with an air volume of 325,000 cub. ft. per hour at a pressure of ¾ lb. or 21-in. water-gauge or 1½ in. mercury.

The inside lining of the cupola is also a very important point in regard to its efficiency. The shape should be like a bottle, with the neck downwards, so as to give the smallest space for the bed and thus reduce the bed coke to a minimum. Foundries casting 60 to 70 tons per day must melt at a rate of 10 to 12 tons per hour so as to allow the men to finish not later than 5.30 p.m.

In charging the cupola the iron, scrap and coke should be *weighed* where an accurate daily report is required, or where a continuous melt is going on for 6 hrs. or more. It is not safe to lay down a "cast-iron" rule in regard to the working of the cupola; it is advisable to allow a little latitude to the charger. There are two systems of charging a cupola, one so as to have a column of coke in the centre with the iron all around the sides, the other is to place the iron in the centre and the coke scattered round the sides. The author prefers the former method, as the flame can then be kept down to invisibility instead of allowing the heat to escape into the air, thereby losing its melting power. The rate of melting by this system is 8.43 per cent., or 11.85 lbs. of iron to 1 lb. of coke melting ratio. (This figure refers to the cupolas at Shaw, Glasgow, Limited.) About 36 years ago the daily cast was increasing considerably, and it was necessary to erect above the blast belt at different heights a number of small tuyeres to increase the melting capacity. They had the desired effect that as the combustion of the coke at these heights and so increasing the length of the melting zone. However, the extra patching and care required to keep these small tuyeres in order was expensive in labour and material, and it was discovered later that by attending to the cupola more closely as it was originally built, the same, if not superior results could be obtained. The cupola used to be built every six months, and it was not until the management found a better patching material that this extra expenditure was found to be unnecessary. It is now three years since the author rebuilt two cupolas, and they are likely to last some time yet. The cupola is one of the most dangerous subjects to discuss, because unless one knows exactly what kind of iron, coke, blast volume, etc., is being used it is very unwise to offer advice.

The speaker then discussed the Poumay cupola. In the course of his remarks he stated that he had gone into the matter very carefully and had come to the conclusion that if the ordinary cupola be as carefully controlled as the Poumay requires to be, the same result can be obtained. He stated that the best the Poumay could give him was 8.5 per cent. coke consumption, or a ratio of 11.18 : 1 inclusive of bed, whilst at Messrs. Shaw, Glasgow, Limited, they had a coke consumption of 8.43 per cent., or a ratio of 11.85 : 1 inclusive of bed. He considered that the total coke consumption should always be stated, and disagreed with the practice of stating only the fusion coke between charges.

A number of slides were shown illustrating cupola construction, etc.

The Jobbing Foundry.

There has been great improvement in jobbing foundries during the past fifty years. In the old days they were usually dark, low-roofed and badly ventilated and almost unfit to work in. The moulder left at night covered with the grime and dirt of the place—the health of the worker was never considered. Jobbing foundries are now designed with some thought for the health and comfort of the moulder. Baths and washing rooms are generally provided so that the dirt may be left in the right place.

The jobbing foundry is usually divided into three sections, green-sand, dry-sand and loam moulding. The two former are considered to be the art, whilst loam-moulding is the science. Patterns are a necessity for green-sand and dry-sand work, but loam-moulding requires mainly sweeps and frames.

It is desirable than an apprentice should be trained in all branches of moulding so that he can be of the greatest use in a general shop. If he is trained in only loam or in dry sand, he will not be suitable for green sand, on the other hand, a man trained in green-sand moulding can more easily adapt himself to the other methods.

The introduction of moulding machines into the foundry some forty years ago led to considerable change in foundry practice. A machine can do much of the hard work and increase the output per man. At first there was great prejudice against the use of machines because of the consequent reduction of labour. The Scottish Moulders' Society actually instructed its members not to work the machines. The employers replied to this instruction by using unskilled men on the machines, since the operation of them did not require any training in moulding. A skilled man was, of course, in charge as foreman. The society, however, soon realised that instead of protecting its members this arrangement was to their disadvantage, because even less skilled men were necessary, so

the ban was lifted. At the present time in some foundries skilled men are employed to operate the machines, which it is thought to be to the advantage of all concerned. The machines used in the jobbing foundry are mainly jolting machines, sand slingers and hand-ram draw-down machines. In conjunction with the latter a stripping plate can be adopted, and this enables the moulder to get a good joint at the parting of the mould. A machine can now be obtained for almost any purpose where mass production is practised.

The power for the machines may be compressed air, hydraulic or electric. Hydraulic power leads to a great amount of inconvenience in the moulding shop, particularly in the green-sand shop, because it is almost impossible to prevent water reaching the sand from leaky joints.

When machine moulding is adopted efficient plant is absolutely essential. In hand moulding a skilled man can always make a decent job even with a bad pattern, but it is impossible in the case of machine work. Consequently, more careful work is demanded of the pattern-maker. A skilled moulder should supervise the preparation of the plant patterns and boxes. There are still some jobbing foundries where machines have not been introduced, but the work in such places is varied and mass production is not attempted. In these foundries a very high degree of skill is demanded of the moulder, the plant is reduced to a minimum and little attention is paid to accuracy of the patterns, and success depends entirely on the skill of the moulder. A number of slides were exhibited illustrating the jobbing foundry of Messrs. Shaw, Glasgow, Limited, and other places.

The Vertically-Cast Pipe Foundry.

This section of the industry was a very important item in the trade of Glasgow fifty years ago, and there were five very large foundries, with an output of 4,000 tons per week and employing 1,600 men, making vertical cast pipes from 2 in. to 48 in. dia. These works were fully employed for many years mainly on work for export, although large water schemes were also carried out at home. D. Y. Stewart was the patentee of the vertical cast pipe. The design of the casting can still be seen in the Glasgow Art Galleries.

At the present time there is not a single foundry making these pipes in Scotland, which means that all Scottish public bodies have to go to England for vertical cast pipes.

There are British Standard Specifications for nearly every kind of pipe made, i.e., water, gas, sewage, soil and smoke. The vertically-cast pipe is still demanded by some for gas and water, and the increased specifying of the 12-ft. pipe has adversely affected the 9-ft. pipe.

The chief trouble is, perhaps, that the cost of manufacture has tended to approximate in the two classes. England has all the advantages, iron, coke and sand adjacent to the foundries, and this makes Scottish competition impossible. The vertically-cast pipe foundry may be divided into four sections, viz., ramming, drying, casting and emptying. Slides were here shown of the vertical-pipe foundries of D. Y. Stewart & Company, Glasgow, illustrating the sections for large and small pipes, and also the sections erected at later dates and designed primarily for the production of hydraulic pipes. Views of the jobbing foundry of this firm were also shown.

Other methods of making vertical-cast pipes are employed, known as the pit or circular method. The same routine of ramming, drying, casting and emptying has to be gone through. Large quantities of skin-dried vertically-cast pipes are manufactured. These are made in stationary boxes, bolted to the side of the pit, with hinges for opening to take out the pipes, and there is a gas jet under each casing. Three pits can be cast each day, that is, ninety 6-in. by 12-ft. pipes is the daily output per pit. In contrast with this, Stanton produce from chills twenty-five pipes 8 in. by 12 ft. per hour, but the cost of the plant is, of course, enormous. Slides were here shown of a number of vertical-pipe foundries.

The Light-Casting Foundry.

The light-casting foundry comprises the production of castings from $\frac{1}{8}$ in. to $\frac{5}{16}$ in. thick. Drain castings may be classed under this heading. There are so many different kinds of light castings that it is impossible to do more than name the most important, such as stove, metal, gutter and rhone, baths, hot-water pipes, rain-water pipes and soil pipes. It is proposed to confine these remarks to rain-water and soil pipes, the manufacture of which is attracting a good deal of attention at the moment..

There are a number of methods used in the manufacture of these articles. The method most commonly adopted all over the country is the one in a box, with board and screw and core box; another is two in a box, with core box which gives increased output without reducing the cost. Then there is the machine method; some foundries put a pattern on a draw-down machine, which reduces the price, but a core box and screw is still used. The most successful machine is the American one, where two pipes are cast in a box and cores rolled up on barrels without screws. This method increases output and also reduces cost. The preparation of the core sand calls for special mechanical assistance, such as mixers, riddles and a Royer-type machine, which blends and aerates the sand thoroughly.

The manner of mounting the patterns on the machine was described with the aid of slides. The ears fixed on the side of the pattern for drawing down and the manner of gating and running from end to end in the centre of two pipes, with inlets every two inches, was also illustrated and described.

The design of the box was next described and the reasons stated for the necessity of the style of box. The method of laying the boxes on rails and the type of core barrel were described.

The core-making machine was illustrated and described. It was explained how the speed of rotation of the barrel affected the core produced. Twelve revolutions of the core barrel were found to give the most satisfactory result. Some of the boxes are machined on the ends to receive the core barrel so that it rests iron to iron to prevent sinking. In other cases there is a sand bearing, but there is a liability to sink under the weight of the barrel. The ladle used for casting is trough shaped, about 5 ft. long by 12 in. wide, with 4 spouts so spaced as to meet the gates on the top of the boxes.

DISCUSSION.

Mr. Longden said that Mr. Macfarlane had given them a most interesting lecture, which had not been confined to the historical aspect as some might have expected from the title. He had left plenty of room for discussion of a subject which would require several Papers to deal with adequately. He personally was much interested in the descriptions of vertical pipe casting, and would like to have heard more about that process. Mr. Macfarlane had thrown a few heavy bricks, especially in regard to cupola practice. The lecturer had referred to only two ways of charging coke and iron in practice, but there were a hundred ways. He has admitted that trouble does sometimes arise and that the furnaceman has to be allowed some latitude of action. He thought that that was a wise decision. The matter was open for discussion.

Mr. James Miller said the lecturer and himself had been at one time very closely related in business for some years, and it had been particularly interesting to him to follow the ground which the Paper had covered. Scotland, it is true, cannot at present boast of a vertically-cast-pipe shop, but he thought that possibly other factors than those mentioned by Mr. Macfarlane may have been, at any rate in part, responsible. The masters, he thought, had been not quite up to date, and the spun pipe had gained a greater hold than it might have done. In regard to the cupola, he could not acquiesce with all that Mr. Macfarlane had said, but he agreed that it was better to allow the cupola man a certain degree of latitude. Mr. Macfarlane had advocated the bottle-shaped cupola, but the great difficulty in his experience was to keep such a furnace to that shape. He would like to know whether Mr. Macfarlane was successful in keeping the shape constantly—that is to say, does he maintain the bottle shape from January to December? He would also like to know about the cutting of the furnace. One had to accept what the author had said about the general run of the castings he had described, but in his long experience of fifty years he must have seen many changes. The shop with which Mr. Macfarlane was connected was in the forefront for equipment, and he would like to know whether the Royer-type machine was used and how he found it to work; if he did not use it would he say what type of machine he used. He (Mr. Miller) thought that the Royer type was of much advantage in green-sand work and to some extent in dry-sand.

Mr. Macfarlane replied that regarding the keeping of the cupola to size and shape they endeavoured to do it—in fact, he could almost say that they did do so. They used a gauge and found that the lining burnt away very little. They used a good patching material, but it could not be done with ordinary ganister.

They had a sand-preparing plant, and he found the Royer quite good. He used it for preparing nearly all the sand used in the foundry. He also used mixers and riddles, and all the machines were used as required.

Mr. Laurie said that he had been interested in hearing about Mr. Macfarlane's lifelong experience. The outstanding feature of the Paper was the advocacy of the bottle-neck cupola. He thought that was a thing of the past, and would himself prefer something more modern. He knew of several firms who had remodelled their plant and who had installed the parallel cupola. One of the great troubles of the bottle-neck form was scaffolding. Had Mr. Macfarlane made up his mind that he would not get as good results from a straight cupola? He thought that the best claim that could be made for the bottle-neck was that less coke was required for the bed, but with a melt to 60 to 70 tons daily the bed was a small item, and if that was the only advantage of the bottle-shaped furnace it should go, as the small amount of bed per ton was insignificant. The spiral tuyere was another very old idea that he himself had tried and, like Mr. Macfarlane, discarded it. Mention had been made of the raising of the melting zone, and his idea was that that was due to the use of too much air.

Mr. Macfarlane's business seemed very complex, dealing with very large and very light pipes and castings. Were these all cast from the same metal? If so, the cupola must work very efficiently.

Mr. Macfarlane, replying, said that with regard to the bottle-neck the real advantage was the reduction in the coke for the bed. Mr. Laurie had suggested that with a melt of 60 to 70 tons it was a small item and did not matter, but he said emphatically that it did matter. He had taken 80 to 100 tons per day from his cupola. There was a receiver to the furnace, and he thought that that was the secret of his success, as there was no slagging and the rate of melting increased as the day went on. He thought that without a receiver the rate would decrease. He used No. 3 and No. 4 foundry pig-iron for both light and heavy pipes, and all were cast from the one furnace. The heavier ones were cost in the forenoon and the light ones in the afternoon, when the heat increased.

Mr. John Longden said that there was just one thing about the bottle-neck cupola and the small well—unless a receiver was attached it

(*Continued on page* 165.)

An Analysis of the Performance of Fifty-Four-Inch Cupolas Based upon Records of Practical Operation.

By Edward E. Marbaker,* Ph.D., Pittsburgh, Pa.

In order to determine as exactly as possible the conditions surrounding actual practical cupola operation, a very comprehensive questionnaire was sent to 136 representative concerns operating cupolas, with the request that information, as complete as possible, be supplied. The response was quite satisfactory, and a considerable amount of material has been made available for analysis.

The comprehensive nature of the replies to the questionnaire was such that some difficulty was experienced in deciding how the analysis should be conducted. It was finally decided to approach the problem from the standpoint of thermal efficiency, that is, the ratio of the heat evolved from the combustion of the coke to the heat utilised in melting iron. It was thought that actual heat balances in which the heat used in melting slag, heating up the lining and that carried off in the stack gases were unnecessary since an approximation can easily be made which will furnish the desired basis of comparison. Moreover, the calculation of heat balances is a highly-technical procedure, and one of the objects of this work is to develop a method for obtaining an approximate value for the efficiency of the cupola operation which can be used by the cupola operator himself without the use of elaborate calorimetric equipment or the need for any special technical knowledge.

It is usual for cupola operators to confine their attention to the melting ratio as a measure of efficiency, but on this basis, obviously it is impossible accurately to compare two cupolas because of the possible difference in the carbon content of the coke and the volume of air used for combustion. In working out the basis for the calculation of thermal efficiency the actual fuel consumption in terms of carbon was used.

It was noted from the questionnaire data that some cupolas are lined straight and others are contracted in diameter from some point below the charging doors to the top of the tuyeres. The latter are said to be boshed at the melting zone. In the course of the investigation the question has arisen as to the effect of the bosh on the thermal efficiency and the melting rate. Therefore, for a given size of cupolas, two classes are assumed to exist, the straight-lined and the boshed, and the summaries have been made accordingly. The value of a second row of tuyeres can also be given some consideration in the comparison.

While all the data desired have not yet been made available, there is sufficient information at hand to warrant a comparison of cupolas lined to 54 inches, inside diameter, on the basis of the calculation already referred to. The general operating results of eight cupolas each of the types under consideration have been tabulated and compared. It is to be noted that the study of the data for only sixteen cupolas cannot lead to authoritative results, but it can point out the tendencies in any given direction.

Discussion of Results.

At the outset a question arose as to the correct method of expressing the output of the cupola. In the questionnaire the total weight of the iron charged was given and also the weight of the iron in the drop. In answer to the question as to the weight of iron melted, the same figure was usually given as that of the total iron charged. In some cases as much as 3,000 lbs. of iron in the drop was reported, and unless the output is very large, this must be taken into account. It was decided to count this iron as not having entered the melting process at all and thus the weight of the iron actually melted has been taken as that of the total charge minus the weight of the iron in the drop. This necessarily affects the figures for the various items all along the line. The foundryman may consider such a quibble unimportant, but if the melting efficiency is to be calculated with anything approximating accuracy, this correction should be considered. The question arises, of course, as to whether the iron in the drop is left unmelted or whether some of it has actually been in the molten state and subsequently cooled. The heat necessary for melting even this amount of iron should be considered, but since there is no way of knowing the conditions, it will have to be set aside and the results will be inexact to just that extent. In each case, therefore, where the figures have been given, the weight of iron melted has been taken as that of the total charge minus the drop.

Effect of Boshed Linings on the Melting Rate.

The melting period and the hourly melting rate need no explanation. The melting rate was recorded to determine the deviation from the normal melting rate as given by the manufacturers of cupolas. This figure for straight-lined cupolas of 54 in. dia. inside the lining is given as 10 to 12 tons. The highest melting rate is 12.67 tons and the lowest 6.67 tons. The average, which actually means little because of the small number of data available, is 10.27 tons, which is approximately the rate given by the manufacturers.

The melting rate of cupolas lined to 54 in. and then boshed to a smaller diameter in the melting zone is quite different. The highest rate recorded for this group was 10.52 tons for a cupola boshed to 48 in. minimum diameter and the lowest rate was 4.36 tons for a minimum bosh diameter of 50 in. Obviously in the latter case the cupola was being purposely operated at a low capacity. The average rate for the eight cupolas was 8.26 tons and the average minimum diameter of the bosh was 46.5 in. Attention is drawn to the fact that the cupola having the smallest bosh diameter (42 in.) showed a melting rate of 10 tons per hour.

While the question of the melting rate in the two types of cupola was under consideration, definite information concerning the location of the melting zone was sought. It was found in all cases that the melting zone lies within the bosh. The inference to be drawn, then, is that the melting rate should be referred to the smallest diameter of the cupola. If this is indeed true, the cupola with the 42-in. bosh showed a considerably higher melting rate than that given in the manufacturer's table for 42-in. straight-lined cupolas, that is, 6 to 7 tons per hour.

In general, however, it appears that the use of a boshed lining decreases the normal melting rate to that of a cupola straight-lined to the minimum diameter of the bosh. The lack of data available in this survey renders the drawing of an accurate conclusion impossible, but the indication is well marked. This is borne out by the fact that in the case of cupola 59b, which is boshed to 48 in., the melting rate shown is slightly higher than normal for a 48-in. straight-lined cupola.

The author holds the opinion that the presence of a bosh is advantageous from the standpoint of combustion conditions, which certainly have a bearing on the melting rate, but the data available are too meagre to prove or disprove the point.

Temperature of the Molten Iron.

The thermal efficiency of the cupola is markedly affected by the temperature at which the iron is delivered at the spout. Obviously, of two cupolas, each melting the same amount of iron by the combustion of the same amount of coke, that which produces iron at the higher temperature has made better use of the heat supply, and is, therefore, more efficient. In three of the sixteen cases no pyrometer was used, and consequently the exact temperatures could not be recorded.

While the temperature of the iron at the spout is used, in the calculations because it is easily measured, it is a fact that the temperature of the iron in the melting zone is much higher.† The efficiency calculated on this basis is, therefore, not the true efficiency but an apparent figure which is necessarily somewhat lower. However, since *comparisons* of performance are being sought, it is quite legitimate to use the temperature of the iron at the spout, and assume that the reduction in temperature due to the passage of the iron from the melting zone to the spout is a constant quantity.

Coke Consumption.

The amount of coke used for the bed varies considerably. In some cases a heavy bed charge is used and the first coke charge is considered to be included. In each case of this kind the weight of the first charge has been deducted from the weight of the bed coke, and the figures record the actual weight of coke used for the bed, thus being directly comparable. The variation is great—from 1,200 lbs. to 4,500 lbs. in the case of straight-lined cupolas, and from 950 to 2,650 lbs. in the case of the boshed cupolas. This variation is due to the fact that even though there is not much difference in the heights of the bed coke above the tuyeres, the tuyeres are set at different heights above the sand bottom, and the bed-coke capacity of the cupolas is different. The size of the coke is also a factor. It is plainly to be seen that there is no standard of practice in this respect. While the maximum and minimum figures are quite different for the two types of cupola, the average weight is only 50 lbs. greater in the case of the straight-lined cupolas.

The variation in the weight of charge and total coke depend upon the melting period and the proportion of coke to iron melted. These figures must be reduced to a common factor before a comparison can be made. The first correction to be made is based on the carbon content of the coke which determines its value as a fuel. It would be preferable to know the actual heating value of the coke in British thermal units as determined by the use of the calorimeter, but in most foundries this is not carried out. The carbon content has not been stated in all the questionnaires, and where it has not, it has been assumed to be 90 per cent. It has also been assumed that none of the coke contains volatile matter, which introduces an error, since most coke contains 1 to 2 per cent., which increases the heating value to some extent. It may be stated, however, that it is very doubtful whether the heat generated by the combustion of the small amount of volatile matter has any effect on the thermal efficiency because of the extremely short time it will remain in the cupola. As a basis of comparison in any case, the assumption is justified.

The hourly consumption of coke or carbon is of interest in indicating the difference in cupola-operation, but it depends upon the amount of iron melted, and since this varies, no comparison is possible. It is necessary, therefore, to reduce this figure to the weight of carbon per ton or per lb. of iron melted. Figures thus obtained are directly comparable, and the weight of iron

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† Grennan, Foundry 51, 908-10 (1923).

melted by 1 lb. of carbon is the *true melting ratio*. The latter means much more than the usual term "melting ratio" because, in determining it, variations in the carbon content of the coke are taken into consideration.

From the data set forth in the tables it is found that in the case of the straight-lined cupolas the true melting ratio varies from 7.00 to 9.30 (lbs. of iron melted per lb. of carbon consumed), and the average is 8.29. For the boshed cupolas the variation is from 7.15 to 9.26, and the average is 8.28. The indication is that boshing of the lining has no appreciable effect on the melting ratio.

Thermal Efficiency.

The thermal efficiency of the cupola is after all the figure which is most desirable as a basis of comparison, because it involves the coke consumption (on the basis of carbon content), the output of iron and the temperature of the iron. A rather simple calculation is used in the determination of the thermal efficiency. The average melting point of grey cast iron is 1,237 deg. C., and the temperature at the spout varies from 1,370 to 1,565 deg. C. as a rule, depending upon the type of castings produced. In order to calculate the quantity of heat necessary to melt the charge and superheat it to the pouring temperature, the specific heat of iron from 15 to 1,237 deg. C. is taken as 0.19, and from 1,237 deg. C. to 1,565 deg. C. as 0.23 B.T.U. per lb. per deg. Fah. This is just another way of saying that relatively more heat is required to superheat iron than to melt it. The latent heat of fusion of iron is 41.5 B.T.U. per lb.

It has been found that the specific heat of iron becomes greater as the temperature rises, and that between 1,237 and 1,565 deg. C. the average value is 0.23 B.T.U. per lb. Therefore in superheating to 1,565 deg. C. heat additional to that required for the mere melting in the amount

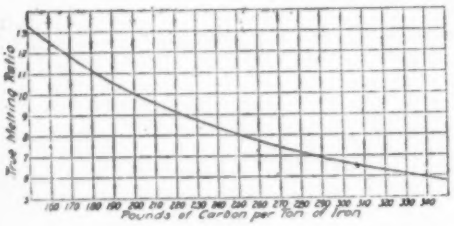


FIG. 1.—TRUE MELTING RATIO FOR LBS. OF CARBON PER TON OF IRON.

of the number of degrees above 1,237 deg. C. multiplied by 0.23 B.T.U. is required. The quantity of heat necessary to change the iron from the solid state to the liquid state at the melting point without change of temperature is called the *latent heat of fusion*. This is 41.5 B.T.U. per lb., and this quantity of heat must be added to the other items.

In the chart of Fig. 1 the true melting ratio (lbs. of iron melted by 1 lb. of carbon) is determined graphically from the number of lbs. of carbon consumed in melting 1 ton of iron. Having found the true melting ratio, and knowing the temperature, the thermal efficiency can be determined from the chart of Fig. 2. For instance, if the true melting ratio is 10.1 (ordinate) and the temperature 1,510 deg. C., the abscissa shows the thermal efficiency to be 39.4 per cent.

The chart of Fig. 3 represents graphically the quantity of heat in B.T.U. necessary to melt 1 lb. of iron and to superheat to the temperature shown on the abscissa. Thus, if the temperature is 1,510 deg. C., the heat necessary to melt and superheat the iron is 572 B.T.U. This applies only to ordinary grey cast iron of the average analysis, as previously explained.

The thermal efficiencies calculated by the methods just outlined are shown in the case of straight-lined cupolas of 54 in. inside dia. to vary from 26.7 per cent. to 37.2 per cent. and the average 31.3 per cent. In the case of the boshed cupolas the variation is from 25.4 to 35.9 per cent., averaging 31.7 per cent. The indication here again is that boshing of the lining has no appreciable effect on the thermal performance of the cupola.

Unfortunately insufficient data are available to make possible a valid conclusion, but certain indications are shown. There seems to be no marked connection between the type of castings made and the thermal efficiency. The coke ratio (lbs. of iron melted by 1 lb. of coke) has apparently only a slight relationship to the actual thermal efficiency, and hence the latter, which has been corrected for several variables, as previously explained, offers a better basis of comparison.

Air Supply.

So much for the side of the story relating to coke consumption. The air supply should now be considered in detail. No standard pressure or volume of air is being used. In two cases no data concerning the air relations were given at all, indicating that a very important means of control is being overlooked in those plants. It is interesting to note that the average blast pressure is 13.5 ozs. for straight-lined cupolas and 11.4 ozs. for the boshed type. This is the condition which naturally would be expected to exist, since probably the principal function of the bosh is to facilitate the penetration of air through the coke bed. The pressure in itself has nothing to do with the actual combustion except to insure the presence of air in the proper place and to maintain the correct rate of combustion. Obviously, with high pressure an excess of air may be introduced, and this will lead to a heavy coke consumption and to oxidation of the iron.

By far the most important factor is the blast volume. When carbon burns to carbon dioxide, that is, when combustion is complete, a very definite weight of oxygen is consumed by each unit weight of carbon. For the combustion of each lb. of carbon 2.667 lbs. of oxygen are required and 14,550 B.T.U. are made available. This, as explained previously, results in the highest possible evolution of heat and is the goal which should be striven for. Three other reactions are possible, but a discussion of them does not properly belong in this Paper.

Under average atmospheric conditions 153 cub. ft. of air is required to supply the oxygen necessary for the complete combustion of 1 lb. of carbon, and this will figure out at 27,540 cub. ft. per ton of iron melted at a ten-to-one ratio, or approximately 30,000 cub. ft. per ton on an eight-to-one basis.

No standard is apparent in the operation of the sixteen cupolas under consideration. A considerable variation in blast volume is shown, but this figure does not offer a suitable basis of comparison, because it has no reference to the amount of coke burned or the iron melted. It is therefore necessary to determine the volume of air supplied per ton of iron melted, and even more specifically, the volume of air supplied per pound of carbon. Considered from these points of view wide variation exists. While it is apparent that an average of the quantities of air supplied is not valid, there is an indication that, for the most part, the boshed cupolas are operated with more air than those that are straight-lined.

Among the straight-lined cupolas three are operated with slightly less than theoretical air for the carbon consumed, three with a decided deficiency, and one with a considerable excess of air. Three of the boshed cupolas are operated with about the same excess of air as the latter, two with slightly less than the theoretical and one with a deficiency even greater than the lowest of the straight-lined cupolas. Strange as it may seem, the boshed cupola, to which the volume of air most nearly theoretical was supplied, shows the lowest thermal efficiency, and that one into which the lowest volume of air was introduced shows an efficiency above the average. The most efficient of the straight-lined cupolas shows an air supply considerably less than the theoretical and the least efficient shows a still smaller amount. These conditions simply point to lack of balance in the combustion. The supply of a deficiency of air to a high coke bed, for instance, will result in the production of carbon monoxide by the reduction of the carbon dioxide first formed by the overlying incandescent coke, according to a reaction which absorbs heat, and which therefore causes a loss of efficiency. The way in which the coke is placed in the cupola and the distribution of the air are therefore important factors to be considered.

Suppose it is desired to arrange the operating conditions of the cupola so that the over-all melting efficiency will be 35 per cent. in melting 10 tons of iron per hr. for 8 hrs. The hourly coke requirement will be 2,420 lbs., including the bed. A bed charge for a 54-in. cupola extending to 30 in. above the tuyeres will be approximately 1,325 lbs., providing the coke weighs 25 lbs. per cub. ft. Theoretically, the bed coke should not enter into the calculation because it acts principally as a refractory support to hold the charges in the melting zone, and the actual fuel should be supplied by the intermediate charges. Actually, some bed coke is always consumed, and in a number of known cases the coke in the drop amounts to 1,000 lbs. Obviously, the longer the heat the less is the

(*Continued on page* 165.)

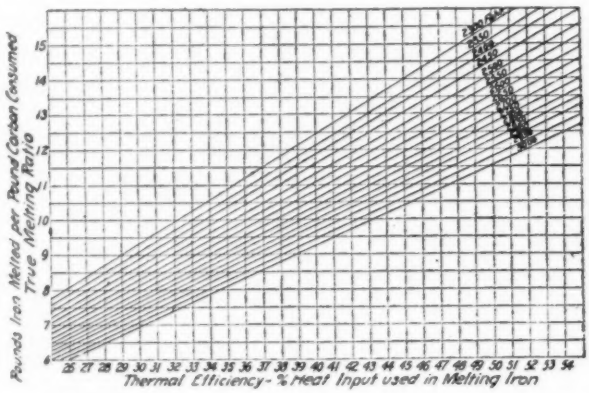


FIG. 2.—CHART FOR DETERMINING THERMAL EFFICIENCY.

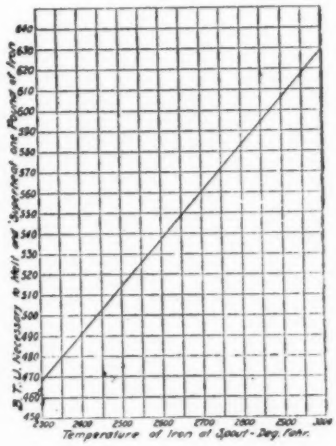


FIG. 3.—B.T.U. NECESSARY TO MELT 1 LB. OF IRON AND TO SUPERHEAT TO DESIRED TEMPERATURE.

More Interesting Moulding Jobs.

MAKING OF HEAVY CASTINGS DETAILED.

MR. E. LONGDEN, President of the Lancashire Branch of the Institute of British Foundrymen, gave a lecture on "Some Interesting Moulding Jobs" before the Birmingham, Coventry and West Midland Branch at Birmingham Chamber of Commerce on January 25. He compared methods of pouring and gating castings at some length, showing many slides in illustration, and dealt with feeding points and moulding operations in a manner which evoked a keen discussion. The lecture embraced much new material and additional illustrations, these being embodied in the following notes:—

Rope Flywheel in One Piece.

The flywheel shown in Fig. 1, weighs 26 tons, is 17 ft. dia. and 5 ft. across the face, including a header of 6 in. on the edge of the rim. The mould was made in cores. When considering the expense of patternmaking and moulding together, this method is most economical when only one or two castings are required; since all the patternwork necessary is a seating-board sweep to form the print to receive the arm and boss cores, a sweep to strike the outside wall, which is actually a print for cores which form the outside of the rim and grooves.

Whilst satisfactory castings are produced when partly coring out the grooves, a much better result is obtained by casting the rim solid. The method of gating and feeding is the same, whether casting solid or partly coring out the grooves.

The wheel is poured through eight top drop-runner gates through the centre boss. The boss is split into four sections by cores, one 2-in. and one 2½-in. gate being located over each quarter. The rim is taken care of by a 6-in. head augmented by six 4½ in. dia. risers, which are rod fed.

The boss sections are also fed through the 2½ in. dia. runner gates. The pouring basin is made in loam and all down-gate entrances plugged with ball-stoppers. The plugs covering the 2 in. dia. drop-gates are first lifted and later, when a good cushion of metal is formed, the 2½ in. dia. gates are opened and the wheel run very quickly in about 3 min.

The metal poured into the casting should carry round about 1.25 per cent. silicon and medium phosphorus, say about 0.75 to 0.8 per cent.; an interesting point may here be mentioned regarding the effect of flash and fin on the local density of the metal. If the illustration of the rope wheel is examined it will be seen that there are marks corresponding to the joint lines of the cores which were used to form the grooves, although the casting has been machined. Actually, the fin of the metal which forms between the cores cools off rapidly, and acts as a chiller to the adjacent area of metal so that when machined the tool rides over the hard places and leaves the marks as seen.

Steam Intensifier: Castings for 6,000-Ton Forging Press.

Fig. 2 shows the principle castings, which are the stools, top and bottom portions, and the middle section, the cylinder.

The top-stool casting weighs about 15½ tons and is made in a loam mould the reverse way to that shown in the photograph. Two 6-in. by 1½-in. in-gates are located to pour in the bottom of the mould, and two 4 in. dia. risers, located on the top flange to be rod fed. The top flange carries a machining allowance ¾ in. to clear scum, etc.

The bottom stool weighs 18½ tons and is also made in loam and again cast the reverse way up to that shown in the picture. Metal is poured through two 4-in. by 2-in. in-gates placed tangentially. The top flange carries again ¾-in. machining to clear scum and, also, four 4 in. dia. feed heads for rod pumping.

The striking of the outer mould is fairly ordinary, but the striking and forming of the core is a very skilled and complicated job, and usually takes from 18 to 20 moulder-working days.

The largest casting, the cylinder, with head, weighs 35 tons and is about 12 ft. 6 in. in length, 9 ft. dia., and 4¼ in. average metal-section. The inside of the casting is quite plain, and gives about a 92-in. bore when machined. The mould and core are swept up in loam and a dry-sand core used for lightening the branch, seen on the right-hand side of Fig. 2.

In pouring, metal is first admitted through the bottom flange by two 4-in. by 2-in. inlet gates, and when about 4 tons of metal has passed through, to form a good metal-cushion filling is completed by a ring of 16 top drop-gates 1¼ in. by 2½ in. Again loam and dry-sand runner-basins, with ball plugs to control pouring, are employed. A low-silicon iron is poured in all three castings.

Castings for Chemical Plant.

Fig. 3 shows three medium-weight castings used in chemical plant. The casting on the left is a 6 ft. dia. cylinder weighing, with header, 2½ tons. The casting is made from a full pattern and sweep-board to form the main body-core and core boxes. The casting is poured in a position which lies at right angles to the picture. Metal is admitted in the bottom flange through two tangentially placed in-gates, 2 in. sq. A 6-in. header is allowed on the top flange (the flange foremost in the picture). It will be noted that this flange carries rectangular cored-holes, which were required to be very accurately spaced, these cores were spiked in the section which form the top flange, so that when the head is cut off the cored holes are there as required.

The middle casting is a hooded plate weighing about 2½ tons, this casting is poured with the face, as exposed in the picture, uppermost, because the other side, not seen, carries considerable machining surface. Pattern equipment consisted of sweeps for the mould and sweeps and core boxes to form the inside and the area between the plate and the serrations or teeth. Metal is passed into the mould through four 1-in. by 3-in. in-gates located on the side of the plate, which is the bottom side when casting. The flange above the cone section

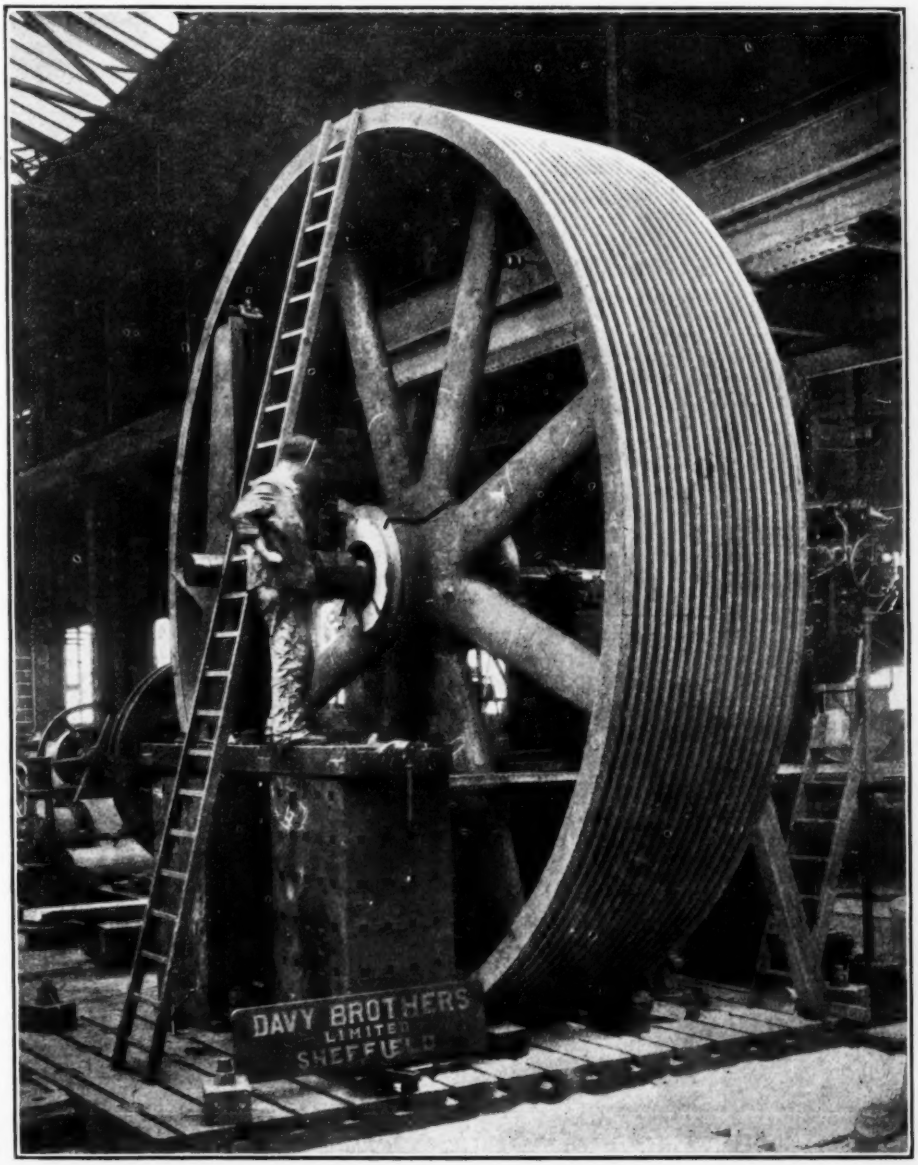


FIG. 1.—ROPE FLYWHEEL WEIGHING 26 TONS, AS CAST, MADE IN CORES.

carries ¾ in. machining allowance to take care of scum, etc.

The box-tube casting, shown on the right of the photograph, weighs about 1¾ tons. A full pattern is used, with a section core box to form the large number of holes, which again were required to be well formed and accurately spaced. The casting is poured with the exposed face down in the mould. The metal is admitted through a series of in-gates passing into each of the sections separating the holes. No feeding is resorted to. Relief risers are carried from four points on the top edge of the casting.

The Wheel and Tyre Rolling-Mill Bedplate.

Fig. 4 illustrates a rather massive bedplate, approximately 32 ft. long by 9 ft. wide, weighing 33 tons. A little more than one-half pattern and core boxes is the pattern equipment required. The pattern is first used to ram one-half of the mould, and is then withdrawn and reversed, with alterations to complete the whole of the mould. This casting is poured by way of the lower face of the mould (casting turned over in illustration) through two 6-in. by 1¾-in. in-gates at each end of the mould and two 3-in. by 1½-in. in-gates placed to pass metal into the deep pocket forming the bearing shown on the left of the picture. Eight risers are located on the top edge of the casting to relieve mould strain at the moment of filling. A 4 in. dia. riser gate is placed for rod feeding the heavy bearing referred to.

Three loam-pouring basins are provided to take the metal from three ladles, two ladles pour the bulk of the metal from each end, a third ladle is only required to fill the heavy bearing before the metal passes to it from a higher level from the ends of the mould. So that several tons of metal is poured, firstly, into this area. This is necessary so that that face of the mould be saved from heavy scabbing, which would almost certainly occur if the quantity of metal required to fill the pocket had first to pass over the face of the mould and then to fall, alternately covering and exposing the sand face of the mould. The camber necessary is downward in the centre ½ in.

Stator-Frame Casting.

Fig. 5 shows a 78-in. stator-frame casting, weighing 12 tons. The mould is made from a full pattern, and the inside (of cores) from core boxes.

The casting was moulded with the front face uppermost and poured through a series of 1½-in. in-gates passing into the base of each of the central vertical sections forming the poles of the casting. The down gates were passed through the cores forming the inside of the casting. Feed risers were placed immediately above each pole section.

Fig. 6 is the photograph of three stator-frame sections, each weighing about 6 tons. Here, again, as with the stator frame previously mentioned, cores constitute a big proportion of the cost of producing the castings. The mould is swept up in loam. Metal is admitted at each end of the mould (the casting is reversed in the photograph) through two 4-in. by 2-in. inlet gates to allow the metal to fill up to the step section when two further in-gates are used to complete a quick filling of the mould. Relief riser gates are placed at intervals on the top face of the castings. A strong close-grained iron is required for the castings.

36-in. Plate-Mill Pinion-Housing Main Castings.

Fig. 7 shows a 36-in. plate-mill pinion-housing main castings. The housing is in three pieces. Each half-housing is about 22 tons and the cap 14 tons. Full patterns and core boxes were provided. The cap casting is cored out to form an oil well. To fill the cap mould with metal, gates are located at each end of the mould, two 3-in. by 1½-in. in-gates are placed on the top-facing seen in the forepart of the picture, and when sufficient metal has been poured a further two in-gates, which are situated on the bracket at a higher point, complete filling of the mould. Feeding risers, about 4 in., are arranged for on the top side of the cap, corresponding approximately to the position taken up by the stud bolts.

The housing casting is cored out leaving the metal section about 4 in. generally and heavier sections at various points. It will be noted that the two half-housing castings are joined together by flanges.

The housing castings are poured with the front face shown uppermost in the mould. Metal first enters the mould through two 3-in. by 1½-in. in-gates situated on the bottom flange, and when sufficient molten iron has passed through to fill the lower face of the body of the casting, two further runner gates, 3 in. by 1½ in., located on the lower plate of the body, complete the filling of the mould. Five 4½-in. feed risers are arranged for, two over the heavy bearings shown in the upper part of the picture, and one on each of the feet and another on the lower heavy section. Low-silicon iron is poured into the castings.

In conclusion, the author wishes to express his indebtedness to Mr. Capron, managing director, and Colonel Bishop, general manager, of Davy Bros., Limited, Sheffield, for permission and help in preparing the data for augmenting the lecture, "Some Interesting Moulding Jobs," previously published.*

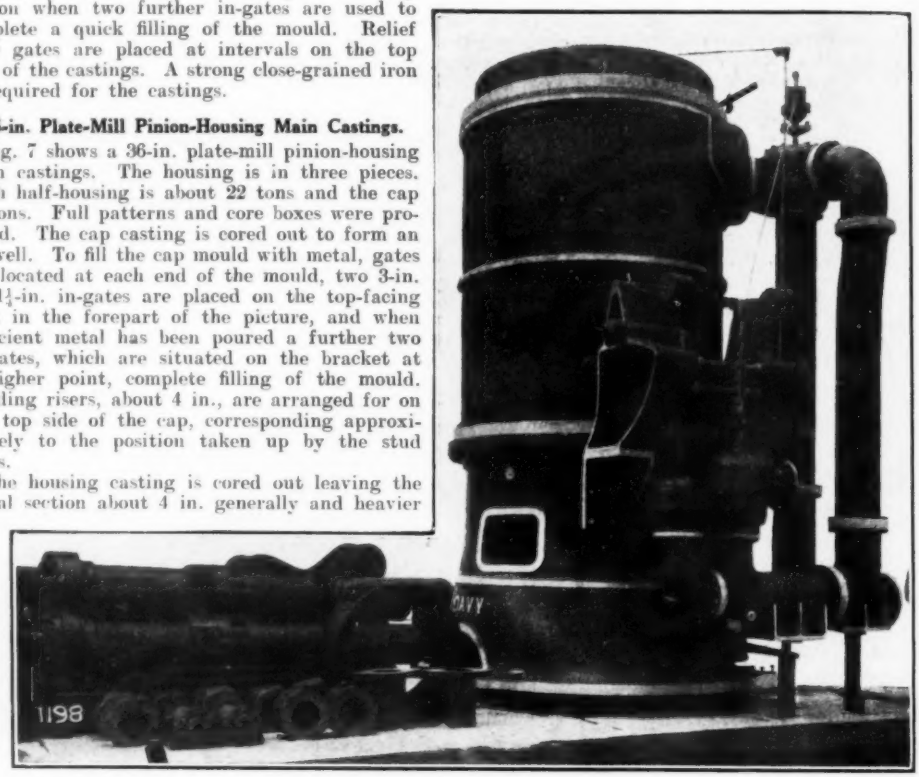


FIG. 2.—CASTINGS FOR 6,000-TON FORGING PRESS.

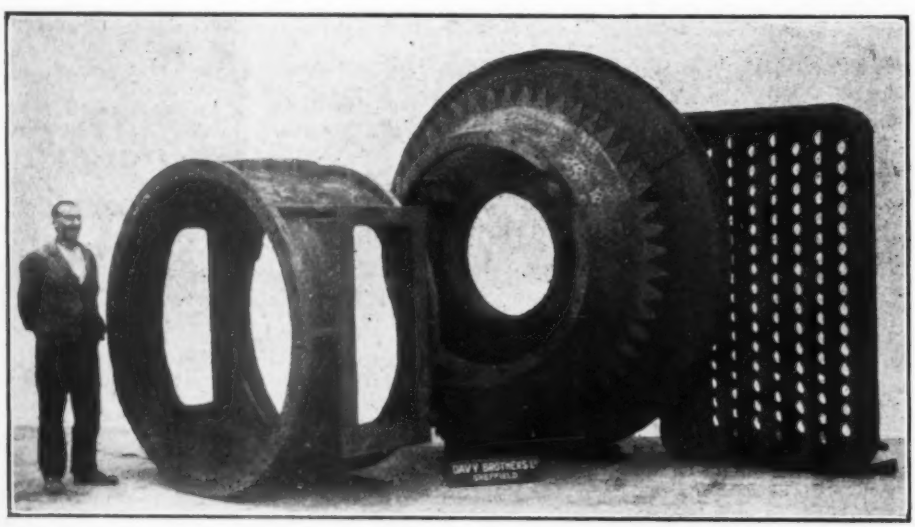


FIG. 3.—CASTINGS FOR CHEMICAL PLANT.

DISCUSSION.

MR. BAKER, proposing a hearty vote of thanks to the lecturer, said much useful information had been given; and MR. GREENWAY, in seconding, expressed appreciation of the fact that Mr. Longden had placed before them the fruits of years of practical work and experience. He endorsed the point that boxes should be made to suit the job in order to save moulding labour. Supporting the vote, the PRESIDENT (Mr. E. H. Tyson) inquired as to the life of 12-ton hematite slag ladles and whether any cracking trouble had been experienced.

Life of Slag Ladles.

MR. LONGDEN said much depended on the way in which slag ladles were used. Some lasted four or six months, others twelve months, when in continuous use. But sometimes they were returned after a month. Very often the trouble could be traced to the metal poured into the ladle, and on occasions there was faulty moulding, the sections being wrong. Then there was a liability to distortion, which was the reason why a hematite iron was used corresponding to No. 3 grade.

Core Bars and Headers.

MR. BAKER, commenting on the collapsible core bar, said his experience was that it was made

* See FOUNDRY TRADE JOURNAL, vol. 40, pages 283, 301, 322.

for releasing the core as soon as possible, so as to allow contraction to proceed and save the casting from splitting or distortion. As to the head on cylindrical castings, he referred to heads of 1 ft. to 18 in. and so on, which had been cited, and said he gathered that, while the heads were carried on the top part, the head itself

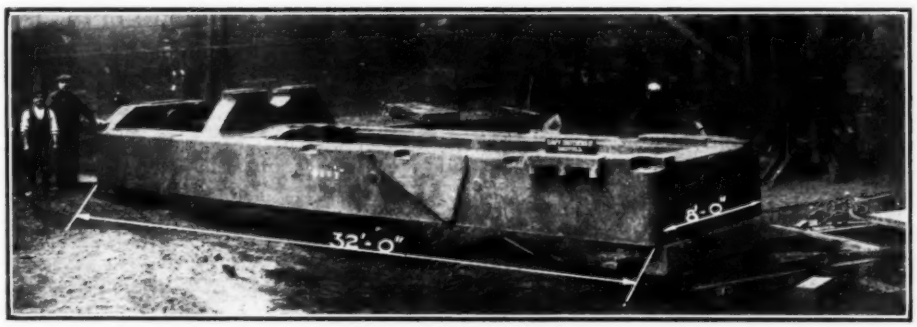


FIG. 4.—BEDPLATE FOR ROLLING MILL.

was closed on the mould, and on the top were additional feeding heads. He himself found that it was much better to put on the head and have the mould open. He had worked on the principle of one-third the length of the casting to give the required head, and it had never shown any cavity or porosity. He attributed the resultant density and solidity of the metal to the work being cast open.

MR. LONGDEN stated that the reason for collapsible core bars was not only to allow for freedom in contraction, as, whilst it did this quite quickly, the primary reason was that it saved the cost of making cores. The ordinary method, of course, was to build up with bricks, etc. He agreed with the speaker as to headers; but when they had to combine top and bottom pouring it was necessary to provide for the proper spraying down of the metal. He had made hundred of castings of cylinders of short stature with an open head, but for castings requiring a long pour he very much favoured the combining of top and bottom pouring in order to ensure a proper hot downward flow of metal.

Composite Castings.

MR. D. WILKINSON, referring to the 28-ton rope pulley (Fig. 1) which had been shown, said it was somewhat surprising that similar trouble

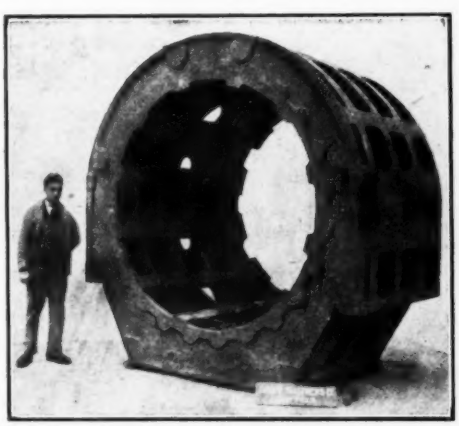


FIG. 5.—STATOR-FRAME CASTING WEIGHING 12 TONS.

had arisen in castings as light as ½ cwt., which required a considerable amount of machining despite largely enclosed cores. By means of a fair-sized fillet round the hole, however, the hard metal could be ground off in the fettling shop. Whilst he should have thought that the weight of metal would have annealed the casting and neutralised the effect of chilling, actually it did not destroy the machinability of the castings. The steel-faced block interested him on account of its perfect line of contact in view of the danger of the steel becoming mixed with the grey iron. Putting in the iron too early destroyed or damaged the steel surface, and they might get a mixed covering of steel, semi-steel and grey iron as a result. As to slag ladles, an initial difficulty was to secure a uniform composition in the metal. The average hematite furnace sold its product under the blessed designation of mixed numbers, and unless great care was exercised they would find wide variations in the silicon content. Provided they were careful, this did not so much matter with steel if too low a silicon content in one heat was avoided; but sometimes there developed a cold heat of steel, and a big difference was then effected in the grey-iron casting.

MR. LONGDEN replied that he had found no difficulty in obtaining hematite pig-iron to a specified analysis in Nos. 1, 2 and 3. The steel-faced blocks and similar castings were a source of difficulty at times, as they all knew from experience. The foreman had on occasions to count in seconds for the pouring. They had, however, secured very good results, and the product had an absolute steel face of 1 in. to 1½ in. (MR. WILKINSON: Did you get a perfect junction?) The lecturer said they did, adding that the iron was poured in before the steel had set.

He preferred to distribute the runners of the mould as much as possible, as this plan minimised distortion and lessened trouble in other ways.

Pouring Wheel Castings.

MR. TYSON, alluding to the rope pulley, remarked that pouring the hottest metal into the outside part of the casting, which would be the last section for the process of contraction, might cause a tendency to grip the spokes. Was not the reason for pouring through the head that the spokes were apt to crack? He suggested curved spokes instead of straight ones, and asked the lecturer's views on inside and outside pouring in this connection.

MR. LONGDEN, in reply, said that running heavy rope pulleys and flywheels was quite a

FIG. 6.—THREE SECTIONS OF A STATOR FRAME, EACH WEIGHING 6 TONS.

different proposition from light and medium castings of the type referred to by Mr. Tyson. Much depended on the ratio of metal in the rim to that in the arms and boss. They would notice that the boss was split into four sections to avoid

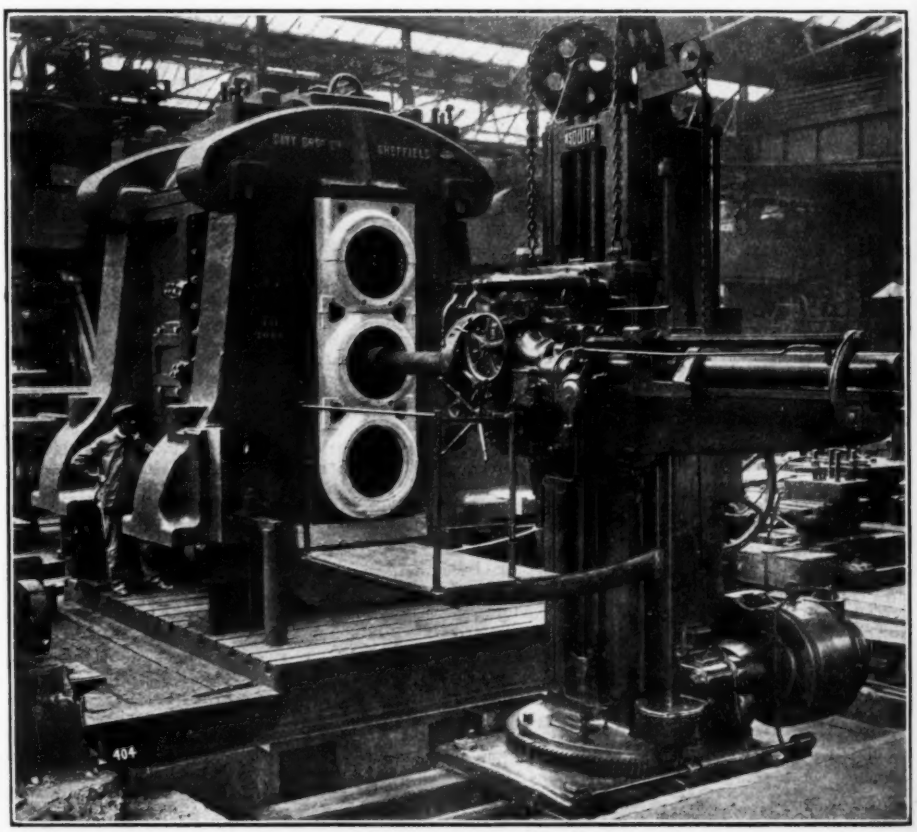


FIG. 7.—36-IN. PLATE-MILL PINION-HOUSING CASTINGS.

contraction and distortion, which some might have overlooked.

More About Slag Ladles.

Considerable discussion followed on the structure of the slag ladle, the lecturer explaining that the mould was on a semi-permanent basis. There was brickwork round the trunnions, which brickwork could be replaced; the moulds were strong enough to be resistant to shell expansion; and the use of a strong sand prevented the trouble of split cores. Replying to Mr. T. H. Turner, the lecturer said the trunnions were solid.

Regarding the steel-faced block, Mr. Longden replied that it required a short annealing to facilitate the "cleaning up" of the steel face, but there was no cracking or distortion.

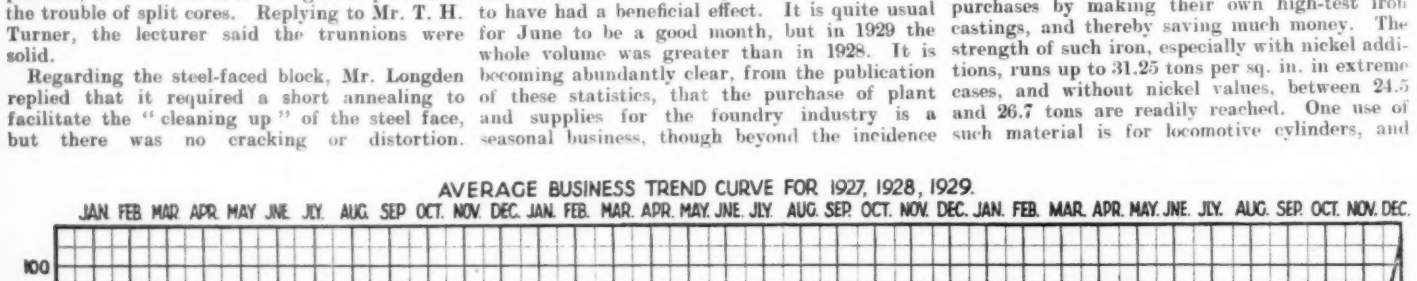
Answering questions as to pouring when a head was needed, he said it was quite sound practice to keep on pouring hot metal into the head. Either a head should be put on at a considerable depth, as he had shown in the chemical-plant castings, or just sufficient for machining. Mr. Tyson stated that in aluminium castings they poured from the bottom where necessary and then at the top, so that the hottest metal flowed where feeding was required. The lecturer agreed that this was desirable where a combination of top and bottom feeding was effective. Mr. W. James, touching on the hydraulic ram slide, endorsed Mr. Baker's view as to the head allowed, and said he found a third of the length was more likely to secure a perfect casting. Mr. Longden remarked that beyond a certain length it took a long run to need more than 2 ft. 6 in. A 12-ft. ram was quite safe with 18 in. of head. Referring to the chemical-plant castings, he said if one did not intend to put on a head that was worth while, it was better not to put one on at all, and just allow for scum clearance—say ¾ in. If they allowed for 3 in. of head, cavities would be found; it was safer to provide for 6 in. or 9 in. to 12 in., according to the depth requirements. Otherwise it was better to put on only ¾ in. of head; this would hide and not disclose the cavity. The resultant surface would be of good metal, which could be machined off clean.

Mr. Longden agreed with Mr. Curnow that making a chill over the arm of the rope pulley would avoid sponginess and scab. Replying to Mr. Turner as to pouring from the bottom, the lecturer showed an illustration of a heavy casting where risers were arranged with sufficient head pressure to pour off in order to ensure soundness. Incidentally, Mr. Longden said he had poured out two tons of metal so as to renew it on the top side of the mould. Quick pouring in massive moulds was necessary in order to avoid scab. The heavy flywheel which he had shown was cast solid and required very quick pouring. Finally, the lecturer dealt with suitable sands for heavy castings, urging proper mixing and adequate proportions of new sand, and incidentally he gave a few hints on the effect of the drying of the mould and radiation.

Last Year's Business Graphed.

Mr. Kenneth Bridges, the hon. secretary of the Foundry Trades Equipment and Supplies Association, has prepared from data supplied by the members the curve reproduced in the diagram reproduced herewith. It clearly shows that the foundry industry enjoyed a year of generally increasing prosperity. The effect of the International Foundry Exhibition is shown to have had a beneficial effect. It is quite usual for June to be a good month, but in 1929 the whole volume was greater than in 1928. It is becoming abundantly clear, from the publication of these statistics, that the purchase of plant and supplies for the foundry industry is a seasonal business, though beyond the incidence of the annual holidays, we are not prepared to enunciate the controlling factors. It is interesting to see that the 108 points registered in December constituted a record; the previous best in any other year was October, 1927, with 38 points, whilst 1919 showed an average of this figure.

AVERAGE BUSINESS TREND CURVE FOR 1927, 1928, 1929.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New Companies.

Jennings Winch & Foundry Company, Limited.—Capital £10,000. Directors: T. A. Matthews, 15, Eldon Street, Sunderland; and F. B. Leithead.

Mitcham Foundry & Engineering Company, Limited, Western Road, Mitcham.—Capital £1,000. Directors: G. Langlands, S. J. R. Badcoe, and R. D. Badcoe.

Wolverhampton Die-Casting Company, Limited.—Capital £3,000. Directors: E. G. Whitehead, V. J. West, 43, St. Judes Road West, Wolverhampton; and R. Whitehead.

Potts & Brown, Limited, Stand Steel Works, Hollis Croft, Sheffield.—Capital £100. Steel manufacturers, etc. Directors: H. A. Potts (chairman and managing director), and E. G. Monypenny.

Pidgen Bros., Limited, 7, Helmet Row, Old Street, London, E.C.—Capital £10,000. Engineers' tool merchants and machine tool dealers, etc. Directors: A. Pidgen, Emma L. F. Pidgen, and E. J. F. Bradley.

John Mills & Company (Llanidloes), Limited, The Railway Foundry, Llanidloes, Montgomery.—Capital £20,000. Ironfounders and engineers, etc. Directors: J. E. Mills, R. R. Mills, Lt.-Col. J. Davies-Jenkins and T. F. Owen.

Reports and Dividends.

Scottish Iron & Steel Company, Limited.—Dividend on the ordinary shares of 6 per cent. for the year 1929.

Mather & Platt, Limited.—Brought in, £108,006; final dividend of 5 per cent., together with a bonus of 5 per cent., making 15 per cent. for the year; carried forward, £109,855.

Westinghouse Brake & Saxby Signal Company, Limited.—Profit, £115,519, including £13,227 brought in; to reserve, £30,000; dividend of 8 per cent.; carried forward, £13,033.

A Review of Metallurgical Development in 1929.

Dr. G. B. Waterhouse, writing in the annual review number of "Mining and Metallurgy," January, 1930, states that the past year was quite active in the field of cast iron. "High-test" cast iron was further developed, the larger corporations replacing much of their steel-casting purchases by making their own high-test iron castings, and thereby saving much money. The strength of such iron, especially with nickel additions, runs up to 31.25 tons per sq. in. in extreme cases, and without nickel values, between 24.5 and 26.7 tons are readily reached. One use of such material is for locomotive cylinders, and one important railway uses iron where the silicon has been reduced below 1 per cent., the manganese increased to about 1 per cent., phosphorus reduced to about 0.1 per cent., and the total carbon lowered to 3.25 per cent. or less. About 0.9 per cent. nickel is usually added in the ladle. If nickel is omitted, the silicon is increased slightly. To get this composition, high percentages of steel scrap are used in the cupola charge, with suitable addition of ferro-manganese. The question of obtaining ample supplies of steel scrap may eventually become acute, and tests were carried out to obtain the same low total carbon by Bessemerising a portion of the cast iron and adding to the next cupola tap. In Europe this blowing in the converter was resorted to in several instances to the full extent of making properly deoxidised steel, but in another case the blowing was only partly done, thus avoiding the necessity of deoxidising before adding to the molten cast iron. In all cases the resulting metal was of the high test variety and of admirable quality.

Chromium has also been added as well as nickel, either in the form of alloy or as Mayari pig-iron, to the charge. Such alloy cast irons are being used where it is desired to have strength, ease of machining, hardness and freedom from chill spots. Cast irons with still greater alloy additions were further developed for resistance to heat and corrosion, as in the case of certain steels.

A commercial method of electrically melting steel scrap or sponge iron to produce pig-iron in the electric furnace was developed during the year. This will be of importance in places where power is cheap.

Pipes Welded by the Resistance Process.—Up to a year or two ago a 6-in. pipe was about the largest size which could be satisfactorily butt welded by the resistance process. Now it is common practice to weld 8 or 10 or even 12-in. pipe by this method. In the opinion of a committee of the American Welding Society there seems to be no reason why a 28- or 30-in. steel pipe, as used in long trunk lines for gas, could not be welded, if the customer would be willing to buy the machine and the necessary power to operate it.

Annual Dinners of I.B.F. Branches.

LANCASHIRE BRANCH.

The annual dinner of the Lancashire Branch of the I.B.F. was held at the Grand Hotel, Manchester. Mr. E. Longden, the Branch-President, was in the chair, and among the guests were Mr. Wesley Lambert, the President of the Institute; Mr. B. Mouat Jones, the Principal of the Manchester College of Technology; Dr. O'Neill, the President of the Manchester Metallurgical Society; and Mr. J. Hetherington Stubbs. Mr. J. A. Robertson, the President of the Manchester Association of Engineers, was prevented by illness from attending.

Mr. R. A. Miles discharged the functions of a toastmaster. After the toast of "The King" had been given by the chairman and duly honoured, Principal B. Mouat Jones proposed the toast of "The Institute of British Foundrymen." He said, when he received the invitation to the function, he looked forward to it with very great pleasure, but when he learned that he was expected to reply to the toast of "Our Guests," he felt rather like the bridegroom who was waiting for his bride on the altar steps, in a rather nervous condition and looking for something. "Have you lost the ring?" asked the best man. "No, but I have lost my enthusiasm." (Laughter.) After his arrival he found he must discard the magnificent speech he had prepared and fill the gap caused by the absence of Mr. Robertson. It was a somewhat terrifying ordeal for an unworldly educationist like himself to face a body of solid hard-headed, soft-hearted practical men who daily faced the stern realities of iron and steel, and moulded things to their will, and then, later in the day, underwent the same process at the hands of their wives and daughters. (Laughter.) But he had come to praise the Institute of British Foundrymen, and he would resist the temptation which beset the wretched layman on these occasions, to say something illuminating upon a subject of which he was wholly ignorant and about which his audience knew everything. (Laughter.) Since he learned he was to propose this toast he had been trying to find out something about the Institute. In the first place, he had always been interested in the industry, largely, he thought, because foundry work must be one of the oldest, if not absolutely the oldest, of all the industries in the world. Its origin was in pre-historic times; he was not sure that it was not anterior to agriculture itself. At any rate, it was a craft which had made modern civilisation possible; without it engineering would be of no avail. To propose the toast of the body which looked after the interests of that industry was a very agreeable task.

Another reason was that for many years the Lancashire Branch had held its meetings in the College over which he had the honour to preside. The Junior Section of the Branch had also done so since it was established. Then he understood the Institute was largely responsible for the starting of the Cast Iron Research Association, which had done very important work in the past, and would do more in the future. His last reason, but not the least, was that he believed the Institute owed a great deal to its general secretary, Mr. Makemson, who was an old Associate of the Manchester College of Technology.

For those reasons he wished the Institute every success and prosperity. With the toast he coupled the name of Mr. Wesley Lambert, a recognised authority upon non-ferrous alloys and well worthy to represent a great institution.

MR. WESLEY LAMBERT replied. He said he was very proud to hold an office which made it his duty to reply to the toast of the Institute. His difficulty was to avoid repeating what he had said on previous occasions. A member of the Birmingham Branch sent him a newspaper cutting reporting the remarks he made at the annual dinner of the Birmingham Branch, and he read it with a certain amount of uneasiness. He reflected that possibly someone might collect his speeches at the various Branch dinners, and send them along so that he might see how often he had repeated himself. According to that report, he began by stating that the Institute was born in Birmingham. This evening he would say that the Lancashire Branch was the first Branch formed after the Institute came into being. Then he said: "The aim and object of the Institute was the non-political furtherance of the foundry industry and the dissemination of technical knowledge appertaining to that industry." What was existing when he made that speech held good to-day—"Its membership was now about 2,000." That was a fortnight ago, and he did not know that there had been any change. "Every endeavour was made to see that the young foundry-worker should receive education in those subjects that appertained to the industry, so that Great Britain might in the future, as in the past, uphold those traditions which the craftsmanship of the foundry so worthily represented." The report went on to say that over a hundred technical Papers would be read during the coming session, a number which would not be approached by any other technical body. He supposed that was true. "The Institute was very proud of its Birmingham Branch, whose members included some of the most active in the Institute." Well, the Institute was also very proud of its Lancashire Branch, which had the largest membership of all the Branches. He could not say that at Birmingham. On that previous occasion he did give thanks for the local hospitality to the overseas visitors who came to Birmingham during the international convention in London in June last, and what he said then he wished to repeat in Manchester. He was one of the party who travelled with the overseas visitors, and besides visiting Birmingham they came to Manchester, and nowhere was greater hospitality shown.

Local Educational Efforts.

The education of the young foundry worker was a thing he had very much at heart, and the Lancashire Branch had done yeoman service for it by the establishment of its Junior Section. For that also he wished to thank the members. The fact that four annual conventions of the Institute had been held in its area was evidence that good organising ability was united with the spirit of hospitality, and in that the Branch had been an example to others. All deplored the loss it sustained through the continued illness of one of its most active workers, and a Past-President of the Institute, Mr. Oliver Stubbs. He sincerely hoped Mr. Stubbs would be restored to health and activity.

What he had to say of the Branch-President, Mr. Longden, might be summed up in one sentence, that the Institute had every confidence in Mr. Longden and wished him a very successful year of office.

He was sure they would all be pleased to hear that great headway had been made in regard to making provision for the future education of young foundryworkers in as many centres as possible. Within the next few days there would be a meeting of representatives of various educational organisations to see whether they could formulate a scheme whereby the young foundry-worker will be able to receive the education in foundry technology which he needs. It was hoped that in the near future the foundry industry would cease to be the Cinderella of the engineering trades and would be put into its rightful position, equal to that held by the mechanical engineer, the civil engineer and the electrical engineer.

MR. J. S. G. PRIMROSE, Past-President of the Lancashire Branch, in proposing the toast of "Our Guests," also referred to the regretted absence of Mr. Oliver Stubbs, and said he was very pleased that his brother, Mr. Joseph Stubbs, was present. (Applause.) Mr. Joseph Stubbs took a very active interest in foundry questions. The duty of replying to the toast would be discharged by Mr. Makemson, the general secretary of the Institute. They had known him well in other capacities, and previously he had preferred to come to the annual dinner as a member of the Branch and not as an invited guest. The members were well pleased that he had accepted their invitation on this occasion.

An Educational Stimulus.

MR. T. MAKEMSON, in replying, said the work of the Institute had always been concerned with the education of foundrymen; it has endeavoured—he thought very successfully—to put before them modern developments on the technical side of foundry practice. In recent years especially much attention had been given to the young foundrymen, the people coming into the trade. To make provision for them the Junior Section had been established. But the technical knowledge required for such a job as that of a foundry manager could not be got merely by attending Junior Section lectures. It was necessary to apply a stimulus to many of the members and induce them to take a greater interest and look elsewhere for the knowledge they required. The Institute was now engaged in a definite national endeavour to encourage the attendance of apprentices at the excellent evening classes established in various parts of the country, and it was believed very shortly they would be able to get apprentices to attend not only existing classes, but also a large number of other classes. At present examinations in foundry practice on a national basis were being arranged.

The average man who took an interest in public affairs generally broke out in the direction of education; that seemed to be one of the things that the average man thought he could do better than the professional educationist. So there was a risk of opinions clashing, but he thought they had avoided that danger. Instead of saying to the educationists, "You ought to do it this way," they asked, "Tell us how in your experience you think this should be done." As Mr. Lambert indicated, the subject had been discussed very thoroughly with various national examining bodies. Anything attempted would be carried through with their advice and co-operation, and, he thought, would commend itself to the people who conducted classes and gave instruction and would be responsible for putting the scheme into practice.

MR. V. C. FAULKNER gave the toast of "The Lancashire Branch." He said, when he came to Manchester on these occasions, he usually gave some indication of the probable trade conditions in the coming year; he was sorry that this year, as far as Lancashire was concerned, he could not hold out much hope. Perhaps foundrymen were in some degree responsible for the trade depression, because they had provided machinery for countries which competed with Lancashire in the cotton industry.

It has been said that successful progress was measured by various stages; the last was when people began to attack your moral character. Well, the Lancashire Branch had not reached that third stage, but perhaps there was some jealousy; because it had the distinction of being the largest branch. He hoped it would continue to grow. The progress it had already made was indicative of the growing appreciation of what was required from the modern foundry engineer and metallurgist. The Institution of Foundry Engineers and Metallurgists would be a truer interpretation of the present membership than its existing appellation.

He coupled with the toast the name of the Branch-President, Mr. Longden, and in this connection he took the opportunity to congratulate

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him upon being appointed to a position in Sheffield.

The Chairman said he felt he would be more at home in discussing a technical subject or writing upon it at his desk than in returning thanks on an occasion like this. The Lancashire Branch certainly deserved a tribute. It had played a very important part in the growth of the Institute's activities, and often the proposals it sent to the General Council had been accepted.

The object of the Institute was to improve the manufacture of castings and the trade in them. They were produced by various classes of labour, and the Institute had endeavoured to satisfy the needs of the various grades of labour by giving what he would call direct education as distinct from purely academic education. What was the attitude of the employers to the Institute? On the whole they were appreciative and helpful, but occasionally they were quite ancient in their ideas and apathetic to the work of the Institute. He appealed to them to give greater support to a body whose work was for their benefit as much as for that of others. It was rather surprising to learn that even to-day the average trade unionist looked upon the Institute as an employers' federation. That was not so. The Institute had no politics, but he was going to make one reference to politics. Personally he was a Free Trader, but it certainly seemed that the foundry trade needed some protection against low prices. The problems it had to face were very great, and how they would be solved he could not pretend to say. Perhaps they must look to some form of combination or association to uplift the trade and those who lived by it, employers and employed.

Diploma for Mr. Longden.

Mr. R. A. Miles said it was the custom of the Institute to present diplomas to the gentlemen who contributed the Papers which were considered the most important. Last session Mr. Longden was successful, a diploma being awarded to him in respect of a Paper entitled "Some Interesting Moulding Jobs," read by him before the Newcastle Branch.

Mr. Wesley Lambert said whatever expression of personal opinion might be made by individual members, the Institute itself was entirely non-political. It did not seek to influence political opinions in any way whatever, nor was it a trade union. It was an educational body and endeavoured to promote the interests of the industry from a non-political point of view by the education of the people engaged in it.

Mr. Longden's Paper thoroughly deserved the diploma which had been awarded, and as President of the Institute it gave him great pleasure to make the presentation to Mr. Longden.

The Chairman remarked that the preparation of a Paper required much time, and it was a consolation to know that the Institute was satisfied with the product of one's labours.

The dinner was preceded by a whist drive and was followed by dancing.

NEWCASTLE BRANCH.

Mr. R. Smith presided over the annual dinner of the Newcastle Branch of the Institute of British Foundrymen, which was held in the Station Hotel, Newcastle-upon-Tyne, on February 8, 1930, about a hundred members, with ladies and friends, being present. The chief guests were the Lord Mayor of Newcastle-upon-Tyne (Councillor Joseph Stephenson), Professor Henry Louis, M.A., D.Sc. (President of the Iron and Steel Institute), and Mr. Wesley Lambert (President of the Institute of British Foundrymen).

Mr. W. J. Paulin (Past-Branch-President) proposed the toast of "The Prosperity of Tyneside." He referred to the fact that to many of them the prosperity of Tyneside was becoming a sort of tradition, that was, they hoped to have prosperity but did not see a great deal of it. All the same, it was a rather striking thing that since coming into that room he had heard that two of them at least were extending their works, which was a very good sign. Although there were many ships laid up in the river, there were no less than thirty-eight laid up at Cardiff. Like many others, they would be wondering how long those who were working would support those who were out of work. Of course, they ought to have a very great sympathy and regard for the men who were out of employment, but the difficulty was that the number of such men seemed to be increasing enormously, and it almost appeared that we were in the position of arranging for a permanent number of men to be kept by the rest of the community. Personally, he felt that that would result in a tendency for those men to lack that effort which might be expected and hoped for. Individual action would help to get them out of that difficulty. Too many of these arrangements were made to provide the men with an easy time.

In response the Lord Mayor thanked Mr. Paulin for his very kind references to himself. So far as trade was concerned, they had been a long time on the keel and the tide had been a long way back. That time was passing and they could feel the water lifting a little bit, although it might not be very perceptible. He thought that the coal trade was improving, and if the coal trade was good one could take it that the iron trade was following very fast in its way. On a whole the trade of the district was improving, and the trade which he happened to be connected with was a great deal better. People were buying more and there was more money about. He had had about forty years of salesmanship himself; people did not come to you to buy an article, you had to take it to them. They had had a great Exhibition, and he was positive that Tyneside and the North-East Coast as a whole had increased their trade as a result of that Exhibition. One thing which he had noticed on the Continent, and that was that the whole of the work was very "shoddy." One did not see the same thing in England, but one had to pay more for articles. Some people wanted the best for very little, but if one wanted a good article one had to pay for it. Tyneside had men who could do work but who had not got work to do. He thought the position was better now than it was twelve months ago. He had known what it was to work; he had worked hard all his life—manual work. Hard work never killed anyone, and a man was happiest when he was working. What they had to do was to try as hard as possible to get work for men who were on the "dole." There were very few who liked to be on the dole, but there was a small percentage who were quite happy so long as they could get someone to keep them.

Professor Louis said that he had had the honour offered to him of proposing the toast of the Institute. It was a task which he would perform with very great pleasure, because he thought few people were better aware than himself of the very high importance of the part foundrymen played in all industries. It was hardly possible to mention any engineering job which did not start in the foundry. He was afraid that when speaking of foundry work he was rather inclined to think only of that branch of foundry work on which he had himself worked and which possibly interested the greater number there, namely, the iron foundry. That, to his mind, was an industry of supreme importance to the whole country. They did not invent iron-founding in Britain; it came to us in the sixteenth century from the Continent, British ironfounders very soon rising to great prominence. In those days the centre of ironfounding was in Sussex, and there was an enormous reputation for the work done there. Their history books always told them of the great triumphs of the sea captains of Queen Elizabeth's reign; he himself thought that, without detracting from the merits of those great men, part of the triumphs should be allotted to the ironfounders who cast cannons for them. Their names ought to go down in history, for they had really laid the foundations of Britain's maritime greatness, and, in that way, the foundations of the whole British Empire.

He honoured the ironfounder not only for what he had done but for what he was doing. There was probably no industry that preserved so much of the true spirit of craftsmanship. An ironfounder had to be thoroughly skilful and have a little of the artist in his composition. When thinking of the work done by moulders and patternmakers one could not help thinking that one had met the true artist and craftsman in the best sense of the word. There had been great advances in the mechanical side of iron-founding, but, after all was said and done, the moulder still had to put the finishing touch to the work. That was what one respected highly and was what put ironfounding in the highest rank of craftsmanship.

The scientific side of ironfounding was of as great importance as the practical side, especially in the making of special castings, and one had to look at an ironfounder from a double point of view—the skilled artisan and the skilled scientist. To keep the industry at a high pitch meant that there had to be a supply of thoroughly adequately trained men; that was where the Institute played an important part. It encouraged men to learn the practical side of the work, and lectures were given on the scientific side. By that combination their Institute helped to keep the high reputation that British foundrymen always had. That was the Institute's real work, to advance both the practical and scientific side of the ironfounder's work.

Mr. Wesley Lambert, replying to the toast, said that he was very glad to be in Newcastle now he had got there. During the last three days he had travelled no less than twelve hundred miles by train, and therefore he was feeling a little shaky that evening. Because of the standing of the Institute of British Foundrymen in relation to other Institutes, he was always prepared to respond to that toast. The Institute of British Foundrymen had for its aim and hope the furtherance of the foundry institute throughout the Empire, more particularly in Great Britain, the assimilation of knowledge by its members, and, further, to give every endeavour that the young foundry worker might receive an education in all subjects required for the foundry industry, so that in the future, as in the past, the splendid traditions of British foundrymen might be maintained.

When he had responded to that same toast in Birmingham a fortnight ago he had expressed his cordial appreciation of the fact that the Institute was born in Birmingham. When he was in Manchester last Saturday he had expressed a like appreciation of the fact that the first Branch which was formed after the Institute came into being was the Lancashire Branch. He had reserved for to-night his cordial appreciation of the fact that the Newcastle Branch was responsible for the first Junior Section. He was afraid that in the Institute they had not so thoroughly appreciated the efforts of those pioneers who had put forward their best efforts with the hope of creating a Junior Branch. It was essential to have good craftsmen, having a knowledge of the science of the foundry. Knowledge was power, and power gave confidence. If they were to uphold the traditions of the British foundry industry, one way in which they were going to do it was by having up-to-date plant, modern process, and knowledge of the science of foundry craft, and they had to see that a young man could come into the foundry and be in a position to receive the education necessary to attain that end.

The Newcastle Branch, of all the Branches of the Institute, had on its Members' Roll a larger number of actual foundry workers than any other Branch. If for that reason only, the Institute

was very proud of the Newcastle Branch, and was also proud of its efforts to maintain the Junior Section. Employers must be encouraged to allow the young foundry worker to have time off if necessary to spend part of the daytime at a technical institute, and, if he was a deserving young fellow, to give him the opportunity of spending several months at a technical institute.

MR. J. SMITH (Past-Branch-President) proposed the toast of "The Ladies," which was replied to by MRS. A. LOGAN. MR. V. STOBIE (Past-Branch-President) thanked Mr. R. Smith (Chairman) on behalf of the members, for his able services, MR. SMITH replying briefly.

Madame Gertrude Hibbs and Messrs. Wm. Hendry and D. Chas. Hibbs entertained the guests.

SHEFFIELD BRANCH.

The annual dinner of the Sheffield Branch was held at the King's Head Hotel, Sheffield, on Friday, February 14. It was very enjoyable and successful, and was especially notable for the attendance of leading citizens of Sheffield—the Lord Mayor (Ald. C. W. Beardsley), the Master Cutler (Mr. A. K. Wilson), the Senior Warden of the Cutlers' Company (Mr. P. B. Brown), the President of the Chamber of Commerce (Mr. R. W. Matthews), and Mr. V. C. Faulkner, editor of THE FOUNDRY TRADE JOURNAL. The chair was occupied by the Branch-President (Mr. G. L. Oxley).

The toast of "The City of Sheffield" was proposed by the President of the Institute (Mr. Wesley Lambert, of Deptford), who referred appreciatively to the hospitality which Sheffield had shown on several occasions when the Institute had met in the city, and also when the Overseas guests paid a visit last May. He said he regarded Sheffield as the principal industrial city of Great Britain, and he called attention to the similarity of Sheffield and Pittsburgh, both having the same interests and both being surrounded by delightful scenery. Sheffield had a wonderful industry, with a world-wide reputation, and he wished it great prosperity.

Apprenticeship in Other Days.

The LORD MAYOR, in reply, said Sheffield was one of the best-governed cities in the country, and outlined some of its public services. Referring to education, he said it cost money, but they received full value for it. The rise of civilisation, through education, had been rapid during the last few years. When he saw the foundrymen in front of him, and thought of the time the moulder used to have in days gone by, he was bound to say that the moulder was getting on. It was a splendid sign when employers and employed could meet for the good of the craft, and also join each other at the festive board—somewhat different from past conditions. The Lord Mayor caused some amusement by reading extracts from the indentures of his father, who was apprenticed to the trade of cabinet-making from the age of 14 to 21. The indentures stated that "taverns, inns, or alehouses he shall not haunt. At cards, dice tables, or any other unlawful game, he shall not play. Matrimoney he shall not contract. Nor from the service of his master, day or night, absent himself, but in all things as a faithful servant he shall behave himself towards his said master and all his family during the said term." To-day he would like to see any employer ask a father to sign a similar document for his son, or even ask the son to sign and seal it. They were progressing rapidly. He could quite believe that the moulder felt the honour of his calling and his craft. He, as an engine driver, was proud of his craft, and when men were happy at their work, he was quite certain there was a bright future for them.

Foundry as Key Industry.

MR. C. W. HAMPTON proposed "The Commerce of Sheffield." One of the objects of such gatherings was to stimulate each other to more enthusiasm for the maintenance of their industry and its betterment. In this respect, they could do a great deal by studying the scientific side and the publicity side. Mr. Faulkner had just given him the interesting information that between 25 and 30 per cent. of the exhibitors at the Birmingham Exhibition were foundry owners. As individuals, whether employers, managers, foremen or craftsmen, they were sometimes apt to wonder whether they counted very much in the turning of the great wheel of commerce and trade. He suggested that they did count very much, and that their keenness on their jobs and keenness to know all that there was about their particular lines was very necessary, and would be far more useful in a very short time, when the present phase of simple cheapness passed away. They in Sheffield had had handed down to them great traditions for quality, which he was sure must tell in the long run. Another way in which they as individuals could stimulate industry was by all buying British goods, as far as possible. He knew the Master Cutler was very keen on this subject, and hoped he would advocate it wherever he went. To buy British was not only taking a patriotic view, but, in his opinion, was a sound investment. Even if it cost them 5 or 10 per cent. more in a year, he was certain that the influence it would have on their trade in England, and particularly in Sheffield, would be so great as to fully compensate for the extra expenditure, apart from the fact that their factories would be much better employed and costs of production would come down very considerably.

Effect of De-Rating on Industry.

The MASTER CUTLER, responding, said he had not a personal acquaintance with his hosts' particular trade, but presumed that they were being affected by the present general conditions. As they all knew, to use the words of the wireless, "unfortunately, at the present time, there is a deep depression centred over the British Isles." The question of unemployment was rightly being stressed by the politicians of all parties, and, naturally, causing great national anxiety. At the same time, he was inclined to think, particularly regarding the Sheffield locality, that the gloomy side was perhaps being slightly overestimated, and that insufficient notice was being attracted to certain favourable circumstances which afforded hope in the future.

In the first place, he would like to draw attention to the change created by the De-rating Act of the last Government. The effect of this measure was that, in considering a site for a new factory or industry, the rates, previously the first consideration, now became a comparatively unimportant item as compared with the cost of coal, electricity and gas, the facilities for transport, and particularly motor transport, the supply of skilled labour, etc. It was no exaggeration to say that by the passing of this Act Sheffield had suddenly become transformed from an undesirable area into one of the most favourable in the whole country to-day.

Another important evolution which had occurred was the importance nowadays of motor transport. Another consideration becoming of increasing importance was the question of water supply. Many cities, already embarrassed for want of water owing to a dry season such as 1929, were in great difficulty in improving their resources. Sheffield was in a better position in this respect than any other large manufacturing city in the country. As the population increased, this question would become increasingly important, and far-seeing industrial concerns would undoubtedly, in the future, make this one of the major considerations when selecting a site for a new works.

New Manufactures.

Again, there was a marked tendency for steel to replace wood for many purposes, such as railway sleepers and railway carriages and wagons. He believed experiments that had been made in this direction so far had been entirely successful, and that in the near future there was every expectation that orders for a large tonnage of steel for this purpose must be placed, from which the Sheffield area would undoubtedly benefit.

So far as the output of steel was concerned, he did not know whether they were aware that the actual production in that area for last year was a record, and exceeded that for any previous period.

With regard to unemployment, he would like to draw attention to an event of great importance which took place on the previous Wednesday, when the Lord Mayor of London inaugurated a national campaign to "Buy British Goods." This campaign was shortly to be promoted in all the important towns of the country, and he hoped and believed that it would receive the enthusiastic support of all members of the community. The amount of manufactured foreign-made goods (excluding goods from the Empire) imported in recent years had averaged the enormous value of £230,000,000. In many articles this represented goods that were made equally well in this country and marketed at competitive prices. The effect of this campaign, if vigorously pushed, would be enormous, and the result, so far as reducing unemployment was concerned, would be considerable. He appealed to every member of that gathering to do his share in insisting upon British goods whenever he made a purchase, provided, of course, that, as was usually the case, price and quality were satisfactory. He also appealed to them to support the scheme when it was officially launched, and, in the meantime, to be talking to their friends and preparing the way.

Co-operative Technical Efforts.

MR. J. T. GOODWIN, in proposing "Guests and Kindred Associations," said kindred associations were represented by the Institute of Metallurgists, Sheffield Metallurgical Association, Institute of Electrical Engineers, Refractories Association and the Cast Iron Research Association. He had noticed with gratification the increase, the prosperity and the general growth of the other associations which had sprung up from time to time. One of their pricipal guests that night was Mr. P. B. Brown, who represented the largest steel foundry in the country, the progress of which was well appreciated in all parts where high and special-duty steels were required. It had been said that there were far too many associations in the city and in the country, that their dates clashed, and that members were unable to attend to the lectures as they should do. In Sheffield, they had successfully introduced a scheme by which they combined for particular lectures, so that the members of all the associations were able to attend. This had been fully appreciated by the members of the individual associations, and the attendances had been exceedingly good

Prominent Steel Founder on Business Prospects.

MR. P. B. BROWN responded, and paid tribute to the craftsmen of Sheffield for their contributions to the city's prosperity, and especially to the moulders, who, he considered, were responsible for the great strides made during the last fifty years. With reference to the Lord Mayor's remarks, he thought that if his Lordship was apprenticing his son to-day he would be advising him to go into cabinet making of another type—he would find more trade in coffin making. In that line the Americans were far in advance of us, because they made their coffins of steel. When in America a few years ago, he was shown a large factory where they made steel coffins, and he was thinking of going back to America and trying to sell them some heat-resisting steel. (Laughter.) Practically the whole of the track work throughout this country was made in Sheffield. That was one thing they were rather proud of, and one of the lines in which the foreigners had not yet been able to make much headway. That, of course, was entirely due to the high

class of steel made in Sheffield, to the very clever and skilled manner in which the moulds were made, and in which the material was afterwards fabricated and finished, trued up, ground and put into condition for a satisfactory and sweet run.

American Enterprise and Tariffs.

On the subject of buying British goods, Mr. Brown said he had rather a curious experience about a fortnight before. An American, connected with one of the largest concerns in the country for the production of manganese steel, had just been on a visit of three or four months to the Federated Malay States. He had heard that quite a considerable tonnage of manganese steel had been sent out there since the war, and inasmuch as the demand in America had decreased recently, he had been out to gather information to enable him to compete in that market. He had succeeded in taking one or two orders back, at a price about 25 or 30 per cent lower than Sheffield's manufacturing cost. He (Mr. Brown) asked him what he thought of Sheffield goods, and the American replied, "Well, we will have to pull up our socks to do any good and knock some of you people out." He then asked him, "How did you get on?" and the American said, "Not at all well, because the whole of the people in the Federated States, who have the purchasing of materials, are imbued with a very extraordinary patriotism, and are all determined to buy nothing but British goods." He (the speaker) then said, "You are an American, and Americans always come down to dollars and cents. How much value can you put on patriotism compared with a tariff of 65 per cent. against our goods going into America?" The American said, "Do you have to pay 65 per cent. to send your goods into America?" He answered, "Yes, and I think it is a bit of a shame that an enlightened American like you should come into this country, and into those Protectorates of ours, where we give you absolutely free entry, and complain of the patriotism which is displayed towards one another, and, at the same time, you seem to think that we are not treating you fairly. Are you treating us fairly when you put a tariff of as much as 65 per cent. against our imports into America?" The American said, "I did not know that that existed." Mr. Brown thought they must continue their crusade of "Buy British." We could not do too much to enlighten those people who were associated with us about the great advantage of buying our own products. Whether the time would come when we should have to raise a tariff against Americans coming into this country, he could not say. It certainly would be a very long time before we had a tariff as high as the one which they had against us.

Professional Consciousness.

He was all out for boosting Sheffield and the British Empire. But he also thought that the moulders and foundrymen ought to start boosting themselves. Now what were they, and what was that great industry with which they were all associated? He maintained that it was one of the most interesting industries and one which required a great deal of handicraft and of science. One could not say that moulding was pure science, such as astronomy, electricity, acoustics, light and heat, and those things which followed fixed laws and which could be calculated to a nicety beforehand. But he did say that moulding required a very high degree of applied science, coupled with highly-skilled handicraft. It also required to be blended, or tempered, or bonded, with a great deal of common sense. They must not let the artist run away with his artistic ideas by taking liberties with the pattern, otherwise they would soon find fault with him. But he must apply science in selecting, first of all, the correct method of moulding, the proper type of box for the article he intended to produce, also in the ramming, venting and preparation and making of the heads and runners, and the other important parts which went to make a good casting. He must also apply a good deal of art to the preparation of the whole of his mould. There was no occupation which required more mathematical and physical effort than that of moulding. What a vista of interesting subjects a moulder had to think of as soon as he was free from his actual occupation! He had to study sand—where it came from, its different characters and qualities, its preparation, bonding and other matters. If he was to be a competent moulder he must have a fairly good knowledge of these things. The use of coal dust for bonding put him into touch with the mine; he came across resins, which took him to Central Africa; blacklead, which took him to Ceylon and India. Looking into all these subjects was bound to make him a very intelligent man. He had to think of the extraordinary material which he was going to put into his mould. He had to have a knowledge of cast iron, steel, brass, bronze, aluminium, the peculiar qualities that they possessed when liquid, when freezing and when contracting. In Sheffield they were very fortunately placed, because their young men could go to the University, and, at little expense to themselves, study all these subjects, which were essential to a man who wished to become a success at their occupation.

Sheffield University.

Mr. Ambrose Firth proposed "The University of Sheffield." He remarked that the opportunities afforded to students in their branches of trade to-day were probably almost unique. Great encouragement was being given to students by one of the London Companies, and prizes were being awarded. Also, thanks to one of the well-known London Companies, and in no small measure to a Past-Master Cutler of Sheffield and to other gentlemen, the University had during the last year installed a certain amount of plant in connection with the cold-rolling and drawing of steel, which would doubtless be of great advantage to many students. This idea was evidently being adopted by other Universities and Technical Colleges in the country, as the firm with which he was connected had quite recently supplied not exactly a similar installation but at any rate a small rolling-mill for a similar purpose at a University on the North-East Coast.

Mr. P. B. Henshaw, who responded, said to his mind a University existed in order that it might make men and women. It was true that the students went there to acquire the latest knowledge of the particular subjects they were studying, but, after all, that knowledge was only given so that they might be set on their feet, that their minds might be caused to apply themselves to the problems of life. When anyone had been through the University, and acquired what the University could give him, he was only just then in the position of being able to see for himself the things that existed and the things that needed improvement. The Institute of British Foundrymen had been one of the societies which had seen this, and which had given every encouragement to the University side of science, and they were to be commended on their attitude. Sheffield was a young University, yet it had been responsible for many great advances; to-day its students were drawn from all over the world. It had possessed professors, particularly on the metallurgical side, who had done a great deal towards the establishment of their industry on its present footing. He had only to refer to Prof. Arnold, who was a pioneer in the iron and steel world from the academic standpoint. Probably Dr. Sorby did more for the science of metallurgy than any man who had ever lived.

Steel Castings Importation.

Mr. R. W. Matthews proposed "The Institute of British Foundrymen (and the Sheffield Branch)." He said in Sheffield they were primarily interested in the iron and steel castings industry. He found, from the latest figures available, for December, 1929, that out of a total tonnage of 13,300 for the whole of this country, Sheffield produced no less than 4,600 tons—rather more than one-third. He also found that in 1927 some 9,525 tons of steel castings in the rough were imported into this country, and that that figure rose to 12,808 tons in 1928 and to 14,156 tons in 1929. There was a distinct tendency towards an increase in imports, and he thought that the figures could not help but be distinctly disquieting to the people of this country and more particularly to those engaged in the steel-castings industry in Sheffield. What the remedy for that state of affairs might be, that was not the time or place for him to endeavour to explain, but, were he pressed privately afterwards, he should have no difficulty in making certain suggestions which he thought would remove the difficulties in the future.

Evils of Political Uncertainty.

He thought this ought to be said, very distinctly: that they in Sheffield were being seriously handicapped at the present time by the uncertainty with regard to the future of the McKenna and Safeguarding Duties. That applied more particularly to those who were engaged in providing materials for the motor-car industry. He did not want them to think that he was approaching this in any spirit of partisanship or politics, but he did know for a definite fact that firms who were engaged in producing the innumerable things that were used in the production of a motor-car—such as castings, forgings, pressings, springs, and all the special steels used in such large quantities for gears, valves, and so on—were being very seriously handicapped at the present time because the motor-car manufacturers of this country, in their present state of uncertainty, were unable to proceed with their programmes, as they normally did at this time of the year, in preparation for the spring trade. A considerable volume of unemployment was being caused in Sheffield as a direct result of this uncertainty.

It was unfortunate for this country that the control of industry was so largely in the hands of politicians. This country needed at the present time a definite national industrial policy, a non-party policy, hammered out not by bodies of theoretical economists who had no practical knowledge of the needs of industry and of the difficulties of production. If we could formulate a definite national industrial policy, which would be readily accepted by all the three political parties, and if the Government of the day could get from those parties an uncontroversial mandate to go ahead with the recommendations of that industrial body, he was certain that in a short time we should be out of the wood and on the highway to renewed prosperity. That time was certainly coming, for at last the nation was beginning to realise industry was its life-blood, that from industry sprang the whole of the wealth for the amelioration of the condition of the people of the country. Now that that realisation was coming, he did think it was more or less practical politics that in the near future we should establish some definite industrial policy.

Mr. G. L. Oxley, responding to the toast, said the Institute had two objects in view. First, they had their educational side, consisting of lectures and works visits, which helped them to improve the products and efficiency of their foundries. Secondly, they had the social side, with its smoking concerts, branch dinners, and other functions. At times the social side needed financing, especially on such occasions as when they entertained the foundrymen from America last June. He should like to thank all those firms and individuals who so generously came forward with help, and made it possible for them to entertain those visitors in a manner worthy of the city. He could assure them that the visitors left with very happy recollections of Sheffield hospitality.

An Analysis of the Performance of Fifty-Four-Inch Cupolas Based upon Records of Practical Operation.

(*Continued from page* 156.)

influence of the bed coke consumption on the over-all melting ratio. In this hypothetical case it is assumed that the drop is 1,000 lbs. and 325 lbs. will therefore be consumed as fuel. For an 8-hr. heat this will amount approximately to 40 lbs. per hr.

In a 54-in. cupola the iron charges are usually 2,000 lbs., and since the melting rate is 10 tons per hr. there will be ten charges per hr. and eighty for the entire heat. If 40 lbs. of coke per hr. is assumed to be the bed-coke consumption per charge, this will amount to only 4 lbs., and it is doubtful whether many cupolas are operated that closely. However, the intermediate coke must be taken as 2,420 − 40 lbs., or 2,380 lbs. for ten charges, and therefore 238 lbs. for each charge. The intermediate melting ratio will then be

$$2{,}000 \div 238 = 8.4$$

which should not be difficult to attain.

When the coke charges have been worked out, it is necessary to calculate the volume of air necessary to burn it completely. It has already been stated that 153 cub. ft. of air are necessary to burn 1 lb. of carbon to carbon dioxide. If the coke contains 90 per cent. carbon, the weight of carbon will be

$$238 \times 0.90 = 214 \text{ lbs.}$$

and the air necessary

$$214 \times 153 = 32{,}742 \text{ cub. ft.}$$

Since ten charges per hour are used, each charge will require six minutes and the supply of air should be

$$32{,}742 \div 6 = 5{,}457 \text{ cub. ft. per minute.}$$

Allowance for slippage and leakage will bring this to approximately 6,000 cub. ft. per minute, which corresponds to the volume of air recommended for this size cupola by the manufacturers.

The cupola may be operated on the basis of these calculations with the assurance that the major conditions have been taken into consideration. It is not expected that exact results will be obtained at the first attempt because of the large number of variables present which are difficult to control. Careful attention to the details of operating the individual cupola should result in good heats within a very short time, however. When this set of conditions has been found to give satisfactory results, the operator should try for a better melting efficiency by making another set of calculations based, let us say, on 40 per cent., and regulate the coke and air accordingly. Higher efficiencies can be obtained by just such careful attention to the details of operation, and with them comes economy in a number of ways. The coke consumption is decreased primarily, and this leads to better iron since the carbon and sulphur contents are also decreased. The melting rate should also be increased.

The question may now be raised as to the value of a boshed lining. The results indicate no especial advantage, but it seems evident that, other things being equal, the weight of bed coke should be decreased because the capacity of the bosh is less than would be the case were the cupola straight-lined. The size of the coke enters into this consideration also, since large coke will fill the space required with a lower weight, and small coke will increase it materially. The coke should not be too large because the surface exposed to the blast air is relatively small, and much of the oxygen may not react and thus be free to oxidise the iron. If it is small, the pressure is increased and the tendency toward slagging and bunging up is increased. The average size which works satisfactorily is 4 to 6 in. The reactivity of the coke must also be considered, but this is a matter so complex that it cannot be covered in this Paper. The bosh has an additional advantage in that it prevents coke and slag from entering the tuyeres, and this in the opinion of some foundrymen is the only reason for using it. From a combustion standpoint, it has a value due to its shape which permits better blast penetration, and tends to keep the air from passing up the walls of the cupola without entering into reaction with the coke.

Conclusion.

Based on a comparison of actual results of practical operation of two series of 54-in. cupolas, a rational procedure for cupola operation has been set forth. It is realised that this does not cover every detail and no attempt has been made to discount the value of practical experience. It is hoped, however, that cupola operators will note the highly variable procedures which are in use and that they will try to adapt the methods outlined to their own practice with the idea of making it conform with the best practice of which records are available.

Scottish Foundry Developments.

(*Continued from page* 154.)

was not possible to gather enough metal. He had had some experience of the Poumay cupola, which gave fairly economical melting, but he found that occasionally melting took place in the vicinity of the upper small tuyeres, and he could imagine that there was danger of bringing down metal higher up the stack, but as he usually melted only some 10 tons daily that trouble did not assume important dimension in his case, as it did not happen during the first three-quarters of an hour. It might, however, destroy the order in which the metal would come down. The Poumay cupola melted well but required a deep bed; 18 in. above tuyeres was hopeless, and it required to be 3 ft. above tuyeres. This reduced the value of small coke ratio between charges. He also found that a good deal of the bed burnt away, and in a long melt the bed required to be made up. Comparing the Poumay and the ordinary cupola, he found that, taking into account the high bed of the former, the coke ratio worked out about the same. He had failed to find the Poumay more economical, but it was an efficient melter, giving hot metal, and worked with remarkable consistency. It was very liable to bridge and work irregularly unless the man was very careful.

The CHAIRMAN, in proposing a vote of thanks to Mr. Macfarlane, said that the lecturer had not given a great deal of historical matter, but he had given a great deal of useful information, especially in regard to the furnace.

German Visitors in Derby.

Germany has displayed much interest in the pulverised-fuel plant manufactured at the Internal Combustion Engineering Company's works at Derby, and last week a party of German experts visited the works. As a result of their visit it is hoped that an important contract will be placed.

The visitors were from Rhinish-Westphalian works, Essen, Hamburg and Berlin, and they were accompanied by Messrs. R. H. Gummer and A. D. Maclean, of the International Combustion Engineering Company, London; Mr. F. G. Penny, the works manager for the company at Derby, and Mr. C. H. Lake.

They had previously been to Birmingham, and whilst in Derby were also conducted over the L.M.S. works.

AT A RECENT JOINT MEETING of the Dalzell Steel and Iron Works Benevolent Committee and the Social Committee, presentations were made to Major Colville, who has resigned the presidency of both committees on being elected a Member of Parliament. Mr. John Lennox, J.P., who succeeds Major Colville as president of the committees, presided.

Pan-European Foundry Congress, Liége, June 22 to 28, 1930.

The International Congress of Mines, Metallurgy and Applied Geology (Foundry Sub-Section), held under the auspices of the Foundry Technical Association, has obtained the support of the following associations:—

Germany.—German Ironfounders Employers' Federation.

France.—French Foundry Technical Association.

Great Britain.—Institute of British Foundrymen.

Italy.—Italian Foundry Technical Association.

Holland.—Dutch Foundry Technical Association.

Czecho-Slovakia. — Czecho-Slovakian Foundry Technical Association.

America.—American Foundrymen's Association.

Belgium.—Belgian Foundry Technical Association.

Negotiations are on foot with the group of Spanish founders.

The International Committee of Foundry Technical Associations, through its President for 1930, Com. Ing. Carlo Vanzetti, C.B.E., has just confirmed its patronage.

The following Papers to be presented have now been announced:—

Mr. J. W. Deschamps, Ingénieur A.I.Lg., managing director of Messrs. Kryn & Lahy, Limited, Letchworth.—*Exchange Paper of the Institute of British Foundrymen:* "Consideration of the Respective Advantages and Disadvantages of the Various Processes used in the Production of Steel in the Steel Foundry."

Mr. Paul Ropsy, managing director of the Société Belge Griffin: "Some Problems of Chilled Cast Iron."

Mr. Arm. Deleuse, Ingénieur à la Fabrique Nationale d'Armes de Guerre, Herstal: "Current Methods of Testing and Controlling Moulding Sands."

Mr. H. Thyssen, Professor at the Liége University and President of the Scientific Commission of the Belgian Foundry Technical Association: "Comparative Study of the Various Methods of Testing Cast Irons."

Scientific Commission of the Belgian Foundry Technical Association: "Application of the Shear Test to the Control of Foundry Castings."

Laboratory of the Compagnie Générale des Conduites d'Eau: "New Machine for Testing Cast Irons using Small Test-Pieces."

Mr. Arm. Deleuse: "The Shear Test by Punching: Its Application to the Control of Thin Castings."

Mr. René Deprez, Ingénieur A.I.Lg.: "The Early History of the Malleable Foundry in the Liége District."

Messrs. Kagan and Deprez, Ingénieurs A.I.Lg.: "Some Remarks upon a Foundry Defect of Malleable."

Dr. Ing. Rudolph Stotz: "Application of Pulverised-Coal Burning to the German Malleable Foundries."

Dr. Ing. Geilenkirchen, Director of the Verein D. E. G.—*Exchange Paper of the German Ironfounders Employers' Federation:* "Furnaces used in the Iron Foundry."

Prof. Dr. Mont. Fr. Pisek, Rector of the Czech Polytechnic at Brun.—*Exchange Paper of the Czecho-Slovakian Foundry Technical Association:* "The Testing of Cast Irons: Considerations based upon the results of Various Tests and, in particular, of the Research made in Czecho-Slovakia."

Mr. H. W. Dietert, Research Engineer to the U.S. Radiation Corporation, Detroit.—*Exchange Paper of the American Foundrymen's Association:* "The Control of Foundry Sands."

The titles of the Exchange Papers of the French, Italian, Dutch and Spanish Associations have not yet been announced.

Department of Scientific and Industrial Research.

REPORT FOR THE YEAR 1928-29.

The Advisory Council of the Department of Scientific and Industrial Research, in their Report for the year 1928-29, point out that in their introductory remarks last year they referred to the necessity of the continuous investigation of what might be called the standard equipment and methods of the older industries. The move made by the British Steelwork Association is a step in this direction, and there have been two other similar developments during the course of the year which are worthy of special mention. The first is the formation of a committee to examine the suggestion that a national locomotive experimental station should be established under the auspices of the Department.

Industrial Research Council for Iron and Steel.

The second important development is the formation by the National Federation of Iron and Steel Manufacturers of an Industrial Research Council to organise and direct investigations of problems bearing on economic production. Previously to the formation of this Council, the Federation had set up a Fuel Economy Committee in 1923, and the work of this committee, which had the financial and technical support of the Department, has been so successful in demonstrating the value of co-operative research, that the Council of the Federation decided that the time was ripe gradually to embark on other investigations of wide interest to the industry.

Such investigations would include the examination of blast- and steel-furnace practice, rolling-mill practice, and allied problems. It is not proposed to carry out independent metallurgical investigations of the type now being undertaken by many industrial and national research laboratories, but to collaborate fully with these so as to assist in the application to industrial practice of the results of scientific research. It is hoped that the new research organisation will also provide an intelligence centre for the exchange of information on all new developments both at home and abroad which have a bearing on the production of iron and steel.

The National Federation applied to the Department for a grant in aid of this scheme for co-operative research. In considering the application it was felt that the scheme was well planned, and therefore it was recommended that for the next five years the Department should make a £ for £ grant in respect of all subscription income received from industry over and above a minimum of £2,000 a year, with a limit of grant of £10,000 a year. The Research Council, on which the Department has two representatives, has started work along the lines indicated. The rightly ambitious plans of the Federation will require a very considerable expenditure if they are to result in a marked effect on the technical organisation and economic success of the industry; and the Advisory Council hope that the preliminary successes of the Research Council will be sufficient to evoke much greater financial support from the industry, which will enable the Council to plan its work on an appropriate basis, and to secure the services of a highly-skilled scientific staff.

Fuel Research.

Referring to the subject of fuel research, the Advisory Council state that during the year the low-temperature carbonisation plant at Richmond which has been erected by the Gas Light & Coke Company on designs developed at the Fuel Research Station has been started up and is now operating satisfactorily with only the minor difficulties inevitably associated with a new operation of this kind. Various low-temperature research plants besides that at Richmond are now working under conditions and on a scale that should enable definite conclusions to be drawn within a few years as to the extent of their commercial success and the probable scale on which they can be profitably worked. Extravagant optimism based on insufficient data seems at last to have been almost entirely replaced by a keen desire to ascertain the facts by properly-controlled industrial experiments. Concurrently with these developments there has been a marked increase in recent years of experiments by the gas industry on the carbonisation of coal at all temperatures. In view of this the Advisory Council thought it wise during the year to ask the Fuel Research Board to review the whole programme of research, which has been devoted so much hitherto to problems of carbonisation.

There were two main reasons, when the Board started its work, for giving a high degree of priority to all problems of carbonisation. In the first place it was considered important, both from the point of view of abatement of smoke and also from the point of view of the production of oil from home resources, to endeavour to put the whole problem of low-temperature carbonisation on a firm experimental basis, and to stimulate industrial development on much sounder lines than existed at that time. In the second place, soon after this work started the Board was asked by the Board of Trade and other Departments to advise on the most suitable composition and quality of gas for public supply. The inquiry made by the Board on this broad subject finally led up to the recommendation and subsequent adoption of the present system of basing the price of gas on its thermal rather than on its illuminating value.

Pulverised Fuel.

The Board now advises that the time has come when priority shall no longer be given to the problems of carbonisation which are of special interest to the gas industry, although they consider that the programme on horizontal retorts should be completed without any attempt to limit its scope. It is proposed that the work should now be developed in other directions. One of these is a general investigation of furnace design, with particular reference to the burning of pulverised fuel. The design of furnaces of all kinds is of immense and wide industrial importance, and is based almost entirely on empirical and traditional knowledge. The chief technical problem is to secure complete combustion in a small space. The successful use of pulverised fuel has been dependent, up to the present, upon the provision of excessively large combustion spaces, for which there does not seem to be any basic necessity. This is a serious handicap when it is desired to apply the system to ships, where conservation of space is of so much importance. Preliminary experiments appear to indicate that combustion space can be very largely cut down without practical disadvantages, and intensive work will be undertaken in this direction. The main problem to be solved is how to make a small particle of coal burn as quickly as possible. The complete examination of this problem will involve physical research of great interest, and possibly of great difficulty.

Metallurgical Coke.

The Board is also exploring in detail an approved scheme into the possibility of making extensive investigations on the production of metallurgical coke. This is a problem of carbonisation which has not been studied with anything like the care and detail it deserves. At present metallurgical coke is only obtainable from certain types of coal, and, although plentiful supplies of such coal occur in some of the British coalfields, it is of primary importance to the coal industry to extend the area of supply as much as possible. There are indications that satisfactory coke can be made from coals and blends of coals which are at present considered unsuitable, but systematic investigations will be necessary to secure this result. Accurate information is also needed on the type of coke oven and treatment which will secure the best results from the coals now used; for instance, there is no general agreement as to the best width and other dimensions of coke ovens, nor as to the best size of coal for charging, nor the time and temperature of carbonisation. Probably all these conditions depend to some extent on the properties of the coal used. It seems clear that the data can only be obtained by experiments on a large scale, such as cannot be carried out in commercial installations without interfering unduly with normal working.

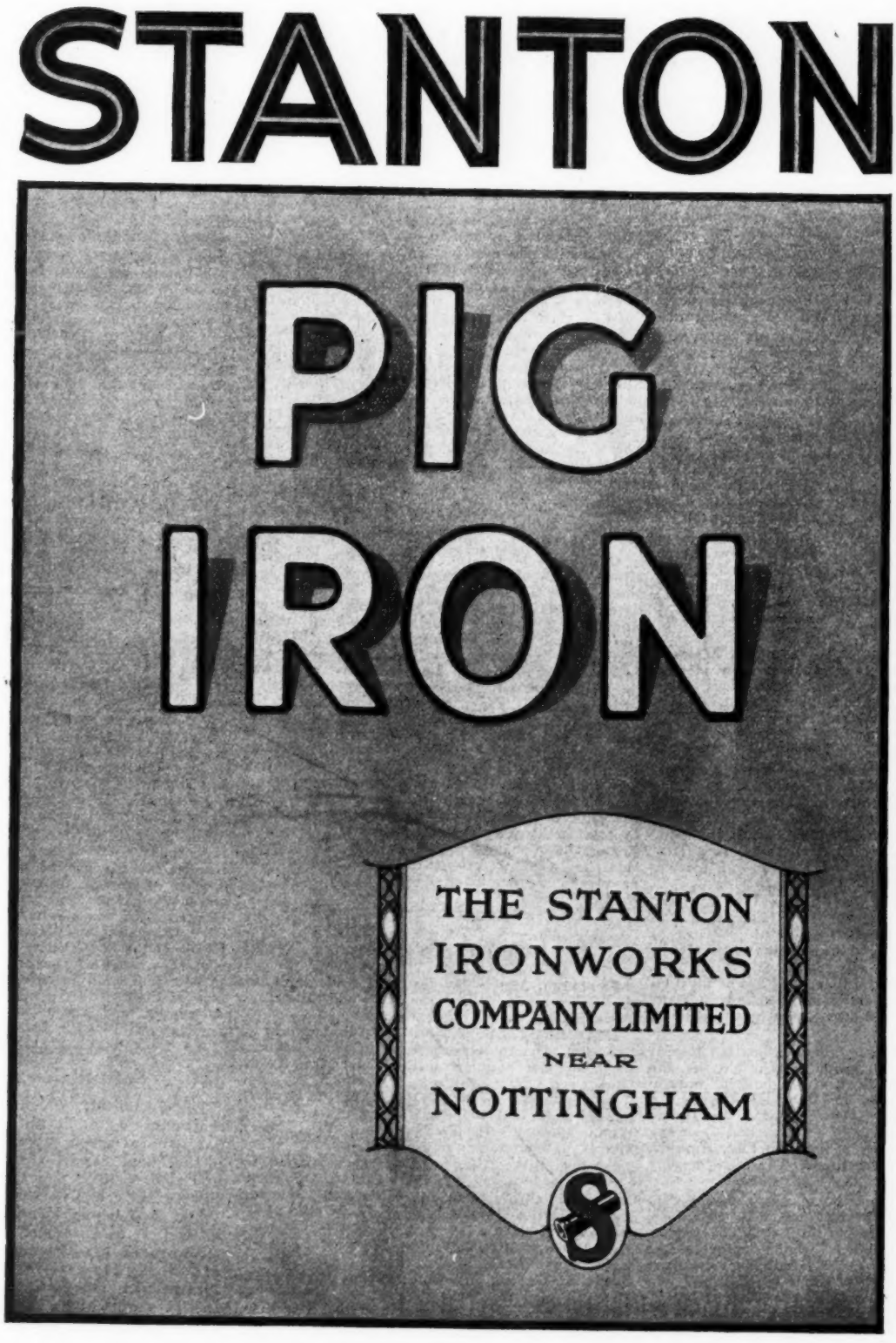
The advisability of erecting an experimental battery of coke ovens at the Fuel Research Station was considered some years ago, but the matter was postponed owing to the urgency of other large-scale work. There would be some advantage, of course, in carrying out investigations of this type in one of the coalfields, but the advantages are not so great as might appear at first sight. Any experimental installation would be a long way from some coalfields, and an installation at Greenwich would have the advantage of close proximity to the research laboratories of the station, and access to other experimental facilities. The Board will submit a considered report on its proposals this year.

Chemical Composition of Tar.

The tar obtained by the carbonisation of coal at low temperatures differs very considerably in composition from high-temperature tar, and has received comparatively little attention from the point of view of its possible uses in the chemical industry. In 1925 it was therefore decided that the Chemical Research Laboratory at Teddington should undertake, in collaboration with the Fuel Research Station, an exhaustive research on the chemical constituents of low-temperature tar obtained from standard coals carbonised under accurately-controlled conditions. There is reason to hope for early practical application of some of the results of the investigations.

It has been shown that the main differences between low-temperature tar and high-temperature tar are that the former contains a much smaller proportion of aromatic hydrocarbons, but a much larger proportion of phenolic compounds, resins and waxes. The phenolic compounds can be separated in a form suitable for use in the manufacture of synthetic resins, germicides, disinfectants and wood preservatives. All these products are in large and growing demand. The aqueous liquors associated with the tar also contain relatively large quantities of phenols, including catechol, which is an important synthetic reagent. If available in quantity from the products of low-temperature carbonisation, its use in the production of drugs, dyes and photographic materials should become more general.

It has also been shown that there are large amounts of different types of resinous materials present in low-temperature tar. As the temperature of carbonisation is increased, these resins tend to disappear and to become replaced by ill-defined and intractable solids. The existence of the resins in low-temperature tar is of considerable scientific interest, and, as they are easily separable in a state of sufficient purity, they should be capable of extensive industrial application. When dissolved in appropriate solvents and applied to wood surfaces, they make excellent lacquers, stains and varnishes. They can be used also as protective films for metal, and can be fashioned into moulded articles when mixed with suitable fillers. The darker resins can be used as components of printer's ink, and even in their crudest forms the resins can be employed for briquetting and similar purposes.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Trade Talk.

MESSRS. FRIEDRICH KRUPP, of Essen, will not declare a dividend for the business year ended September 30, 1929.

THE EMPLOYEES of Messrs. Bull's Metal & Melloid Company, Limited, Yoker, Glasgow, have contributed to local institutions the sum of £94.

THE ALBION STEELWORKS, Briton Ferry, after a stoppage of three months, was restarted on February 24. The firm employs 400 men.

AT A RECENT MEETING of the Falkirk Dean of Guild Court, permission was granted to the Carron Company to extend their forge department by an additional bay, and also to dismantle and reconstruct their die store.

THE RANSOME & MARLES BEARING COMPANY, LIMITED, Newark-on-Trent, were awarded a gold medal at the International Exhibition at Barcelona. They were the only British ball-bearing company to be awarded a medal at this exhibition.

THE BIRKENHEAD CORPORATION ELECTRICITY COMMITTEE have accepted the tenders of Messrs. Mather & Platt, Limited, Manchester, for converter plant, and of the Metropolitan-Vickers Electrical Company, Limited, Manchester, for a metal-clad switchboard.

MESSRS. GEORGE BROWN & COMPANY, LIMITED, Garvel Shipyard, Greenock, have received a contract for a salvage vessel from Canadian owners. The vessel will be 130 ft. long and fitted with Diesel engines supplied by Messrs. Worthington, Simpson, Limited, London.

THE HOLDERS of the first debentures of the Aluminium Corporation, Limited, at a meeting held in London, assented to the release of the rights of the debenture-holders against the company conditionally upon a scheme of reorganisation of the loan and share capital of the company becoming operative.

MESSRS. HARLAND & WOLFF, LIMITED, have launched from their Belfast yard the twin-screw motor cargo vessel "Silver Cypress," the first of four similar vessels ordered by Messrs. Stanley & John Thompson, Limited. The vessel is of 6,200 tons gross, and will be fitted with Diesel engines by the builders.

MESSRS. CHRISTMAS & WALTERS, LIMITED, announce that on the termination of their present lease they are moving into more commodious offices at 8, Grosvenor Gardens, London, S.W.1, to-day. Owing to the extension of their business, the directors are being increased in number by the inclusion of Mr. R. E. Christmas.

THE CENTRAL ELECTRICITY BOARD have placed contracts amounting in all to approximately £150,000 for 132-kilovolt transformers in the area of the Mid-East England Electricity Scheme, with the following firms:—Messrs. Ferranti, Limited, Hollinwood, Lancs; the Fuller Electrical & Manufacturing Company, Limited, London; and the General Electric Company, Limited, Witton, Birmingham.

MESSRS. BARCLAY, CURLE & COMPANY, LIMITED, have launched from their Clydeholm yard the steamer "Contessa," built to the order of Messrs. Vaccaro Bros., of New Orleans. She is of 397 ft. long, 53 ft. 6 in. breadth and 33 ft. depth. The propelling machinery, consisting of a set of inverted four-crank quadruple-expansion engines of the balanced type, has been constructed by the builders at their North British works.

IN ORDER to obviate competition in foreign tenders and to strengthen the position of the export market the principal builders of railway and tramway carriages in Italy have formed a joint company, which is to be styled the Italian Consortium of Exporters of Railway and Tramway Vehicles. The members include the Fiat, Ansaldo, Breda and several other firms. The new company will also facilitate the financing of orders.

THE TOTAL OUTPUT of the members of the Continental Steel Cartel in 1929 was 34,953,000 tons, or 2,494,000 tons more than in 1928. The production thus largely exceeded the allotted quota free of fines. The figures for the individual countries were:—Germany, 16,246,000 tons (or 1,729,000 tons more than in 1928); France, 9,664,000 tons (an increase of 296,000 tons); Belgium, 4,132,000 tons (an increase of 198,000 tons); Luxemburg, 2,702,000 tons (an increase of 135,000 tons); and the Saar district, 2,209,000 tons (an increase of 136,000 tons).

THE CONTINUOUS OPERATION of the steel plant of the British Empire Steel Corporation at Sydney, Nova Scotia, is assured up to a date well into the summer as the result of the receipt recently of important orders from various railway companies. Following upon the order for 80,000 tons of steel products for the Canadian National Railways, it is officially announced that the New York Central Railroad has placed an order for 12,500 tons of heavy 127-lb. rails. This latest order is the third to be received from the New York Railroad during the past three years, and it is expected that work will be started almost immediately.

THE ANNUAL DINNER of the Institution of Mechanical Engineers was held at the Victoria Station Hotel, Nottingham, on February 15. Mr. G. W. Woolliscroft (chairman of the Branch) presided, and amongst the prominent personnel present were the Lord Mayor of Nottingham and the Lady Mayoress, the Lord Mayor and Lady Mayoress of Leicester, Sir Henry Fowler (Derby), Mr. H. H. Morley (President of the Nottingham University College, Engineering), Dr. D. Adamson (President of the Institution of Engineers), Dr. A. Bramley (Loughborough College), Mr. C. G. H. Richardson (President of the Newark Engineering Society), and Mr. B. P. Cooper (President of Leicester Branch).

THE PRESIDENT OF THE BOARD OF TRADE has set up a committee to examine the present situation as regards the British Industries Fair and to consider what means can be adopted to increase still further its utility to British trade. It is hoped that in the course of their inquiries the committee will investigate and report on the following questions:—The possibility of extending the scope of the fair; the date on which the fair is to be held, and the desirability of holding a second fair in the autumn; the limitation of participation to manufacturers; the best means of advertising the fair, and of financing the publicity campaign; the possibility of holding the fair, or sections of the fair, at centres abroad; and the possibility of organising a travelling fair either in ships or trains.

MR. JOHN CRAIG, of Messrs. David Colville & Sons, Limited, discussed some of the problems of the heavy industries in an address to members of the Edinburgh Chamber of Commerce. He referred to the burden of taxation placed on the industries after the war. Companies were left with additional plant which was unproductive, but which was believed to be a fine source of additional taxation. Another fundamental blunder which had caused great difficulty was the introduction of the fatal mistake of basing wages on the cost of living and not on the profit on the labour. Again, there was the mistake of putting their transport system on a guaranteed basis. In a ton of pig-iron sold in the Midlands from Scotland at 100s., 33s. went to the railway companies in cost of transport of raw material and in actual carriage. Was rationalisation the cure for the depression prevailing? They had been told it was. He did not regard rationalisation as a food; it was purely a medicine. They were not going to feed a developing country on rationalisation. If this were to be the policy of this country it must be a policy of cutting down. Rationalisation simply meant fitting their production to their powers of consumption.

Contracts Open.

Edinburgh, March 24.—Iron and steel stores, for the Corporation. The Engineer and Manager's Office, Dewar Place, Edinburgh.

Johannesburg, April 3.—Structural bridgework, for the South African Railways and Harbours Administration. The Department of Overseas Trade. (Reference A.X. 9,162.)

London, S.W., March 5.—Metals, for the Bombay, Baroda and Central India Railway Company, The White Mansion, 91, Petty France, Westminster, S.W.1. (Fee 10s., non-returnable.)

London, S.W., March 14.—2,000 axleboxes for carriages and wagons, for the Madras and Southern Mahratta Railway Company, Limited, 25, Buckingham Palace Road, Westminster, S.W.1. (Fee £1 1s., non-returnable.)

Southwell, Notts., March 6.—275 tons of cast-iron pipes, etc., for the Rural District Council. Messrs. Sands & Walker, Milton Chambers, Nottingham. (Fee £3 3s., returnable.)

Sydney.—Brick-making machinery and semi-Diesel engines, for a local brick and tile company. The Department of Overseas Trade. (Reference A.X. 9,165.)

Whitefield, Lancs., March 10.—Pumping station, etc., for the Urban District Council. Mr. G. Bertram Kershaw, civil engineer, 9, Victoria Street, Westminster, S.W.1. (Fee £5, returnable.)

Ystrad Mynach.—Iron and steel stores, for the Powell Duffryn Steam Coal Company, Limited.

Personal.

MR. J. E. HURST, the well-known foundry metallurgist, has changed his address to "The Beeches," Green Lane, Dronfield, near Sheffield.

AN INTERESTING CEREMONY took place in the laboratory of the Coltness Iron Company, Limited, Newmains, recently, when Mr. Neill Hogg, a member of the chemical staff, was presented with a wallet and gold-mounted fountain pen, together with other tokens of esteem, by his associates, upon the occasion of his leaving to take up an appointment with a London firm of consulting metallurgists and chemists.

MR. S. NICHOLS, who has been for some years manager of the Middlesbrough office of the British Thomson-Houston Company, Limited, is now relinquishing this position to become manager of the company's Liverpool office at 27-29, Stanley Street, Liverpool. Mr. A. D. Mackinnon, for many years a member of the company's Glasgow office staff, has been appointed manager of the company's Middlesbrough office.

IT IS PARTICULARLY PLEASING to us to announce the appointment of Mr. W. R. Long as London manager of Messrs. Stewarts & Lloyds, Limited, Winchester House, Old Broad Street, London, E.C. For 10 years Mr. Long was our colleague as advertisement director of THE FOUNDRY TRADE JOURNAL. In that capacity he covered the whole of Great Britain, and made a host of friends in the metallurgical industries. We can assure Mr. Long that he has the best wishes of the whole of the foundry industry for success in his new position.

Wills.

NORMAN, P. G., managing director of Messrs. Tuke & Bell, Limited, and of the Lichfield Foundry, Limited ...	£8,900
PORTWAY, H. H., of Bois Hall, Halstead, Essex, ironfounder, of the Tortoise Foundry Company, Limited, and of Messrs. Charles Portway & Son ...	£123,232

Obituary.

MR. J. C. J. SMITH, chairman of the Camelon Iron Company, Limited, ironfounders, Falkirk, died recently.

WE REGRET TO ANNOUNCE the death of Mr. Henry James Williams, of 205, Carlton Road, Worksop. He was director and manager of the Worksop brick works of the General Refractories, Limited, Sheffield, and a brother-in-law to Mr. Frank Russell (managing director). In his younger days he was a noted swimmer and water-polo player.

MR. A. A. CAMPBELL SWINTON, F.R.S., the distinguished electrical engineer, died recently in London, at the age of 66. Mr. Swinton was a director of Messrs. Crompton, Parkinson, Limited, and of the Parsons Marine Steam Turbine Company, Limited. He was a member of the Institutions of Civil, Electrical and Mechanical Engineers and a Fellow of the Royal Society, and he served as chairman of council of the Royal Society of Arts in 1917-19 and again in 1920-22. He was also chairman of the British Scientific Instruments Research Association, and a member of the general board of the National Physical Laboratory.

Patents Committee, 1929.

The Committee, which was set up under the chairmanship of the Right Hon. Sir Charles Sargant to consider whether any amendments in the Patents and Designs Acts, or any changes in Patent Office practice, are desirable, are continuing their weekly meetings at the Board of Trade for the purpose of hearing evidence from interested persons and associations. Twenty meetings of the Committee have taken place, and during the next few weeks evidence will be taken from representatives of the Chartered Institute of Patent Agents, the Law Society, and several Chambers of Commerce.

Any persons or associations who desire to submit any further suggestions, or to give evidence, should notify their intention to the Secretary to the Committee, Mr. R. W. Luce, Industrial Property Department, Board of Trade, 25, Southampton Buildings, W.C.2, not later than May 1 next.

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THIS IS JUST AS TRUE OF STEEL MOULDING SAND

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Conditions in the Cleveland iron trade during the current week have disclosed very little, if any, improvement in market movements, and from present appearances there seem faint hopes of an early revival of activity in that direction. Unquestionably, fears of increased taxation and apprehensions regarding the Coal Mines Bill are contributory factors, but the apathy of the market is directly attributable to the general state of lethargy which is apparent throughout the heavy industries, and it may be foolish to build extravagant hopes, on the possibility of spring revival. As regards home consumption, all the causes above cited are operating adversely to retard purchasing on forward account, furnaces having already contracted heavily to cover requirements over the first quarter, and some accumulations have already been noted in stocks in maker's yards. Amongst consumers the opinion has not been abandoned that pig-iron prices must fall. But Cleveland ironmasters give no encouragement to that view. They still firmly adhere to their fixed minima of 72s. 6d. per ton for the standard No. 3 Cleveland G.M.B. quality, 75s. for No. 1 foundry, 71s. 6d. per ton for No. 4 foundry, and 71s. for No. 4 forge.

In the market for East Coast hematite, though less active than recently reported, business continues fairly steady, and a few more export sales have been effected. Prices are not fixed, and there is keen competition for orders. However, 78s. is still a recognised market rate for East Coast mixed numbers. On the North-West Coast Bessemer mixed numbers are quoted at 79s. per ton at works.

LANCASHIRE.—It is satisfactory to record, in connection with pig-iron markets in this area, that although conditions generally are anything but flourishing among Lancashire foundries, there is still no very marked decline in the rate at which delivery specifications for foundry iron are being received. Quotations for Staffordshire and Derbyshire brands remain at 77s. per ton, with Scottish iron, the demand for which is quiet, at around 95s., all per ton delivered local stations.

THE MIDLANDS.—Producers of foundry pig supplying the needs of consumers in this district report that, although new business has not been coming forward in large quantities of late, there is still a considerable amount of iron going into consumption which has been specified against existing contracts. Current prices are firmly held, zone figures still ruling at 75s. for Northants No. 3 and 78s. 6d. for North Staffordshire and Derbyshire No. 3, delivered to local stations.

SCOTLAND.—Only a moderate volume of business is passing in the Scottish pig-iron market, and with a few exceptions works generally continue on short time. Buying, where it is taking place, is of a hand-to-mouth character, and whilst consumers, looking at the easier ore and fuel markets, plus the foreign competition, think they should be getting pig-iron at lower prices, makers say they cannot afford any reductions. The basis price of No. 3 Scotch iron, therefore, remains at 78s. f.o.t. furnaces, with 2s. 6d. extra for No. 1.

Finished Iron.

At Birmingham business in crown and the cheaper grades of iron continues to be dull. There appears to be no movement one way or the other. There is a large amount of competition for what business is developing, and prices for crown bars vary according to the district from which they come and are at anything from £10 to £10 10s., with £9 2s. 6d. to £9 7s. 6d. as the price for nut and bolt bars. The only bright feature in connection with the iron trade is the continued support being given to the makers of marked bars, who continue to be fairly well occupied. No difficulty is experienced in getting the price of £12 10s. at works.

Steel.

In the markets for semi-finished products, home manufacturers have recently experienced a somewhat better demand, and apparently less business is going to Continental competitors. At Sheffield, there is an air of caution in the steel market, and buying does not get beyond the hand-to-mouth description. In high-grade special steels the position is fairly satisfactory; it is in the cheaper steels that the paucity of orders is most felt. There is continued slackness in Siemens acid billets, but in basic qualities business is moderately good, despite the competition from the Continent. Wire rods are also feeling the effects of price-cutting by Continental producers. No price alterations are notified. In the tinplate market, prices remain fairly steady, current quotations ruling:—Coke tinplates 18s. 6d. to 18s. 9d. basis, net cash, f.o.b. Wales.

Scrap.

Markets for foundry metal scrap continue quiet, and it is nowhere possible to discover a substantial outlet for material, while consumers generally seem determined to hold off the market as long as possible in the hope of lower prices. On Tees-side the foundries are still paying the same figure for ordinary heavy cast iron, but the demand for machinery quality has fallen away, and handy lots are now on offer at 65s. per ton, with few buyers. In the Midlands, there is a fairly good demand for heavy machinery cast-iron scrap, for which 70s. can be obtained. Light cast iron is weak, 57s. 6d. to 58s. 6d. delivered being the general price ruling. In Scotland, dealings in the market for cast-iron scrap are restricted in volume, with heavy machinery quality quoted at 70s., ordinary heavy 63s. 6d. to 65s., and light material 60s., all per ton f.o.t. delivered consumer's works.

Metals.

Copper.—Recent movements in the market for warrant copper have disclosed a steady upward tendency in values, the close last week showing an advance of nearly £2 in the position for cash, and this has resulted in spite of the fact that there has been a considerable decrease in refinery production, the copper statistics revealing the fact that stocks at refineries have grown still larger. An increase was expected, but it was not considered probable that it would be to the extent of 32,100 short tons, making the total stocks 203,500 tons.

Closing quotations are :—

Cash.—Thursday, £69 17s. 6d. to £70; Friday, £69 15s. to £69 17s. 6d.; Monday, £69 10s. to £69 12s. 6d.; Tuesday, £69 5s. to £69 10s.; Wednesday, £69 10s. to £69 12s. 6d.

Three Months. — Thursday, £68 15s. to £68 17s. 6d.; Friday, £68 12s. 6d. to £68 15s.; Monday, £68 15s. to £68 17s. 6d.; Tuesday, £68 15s. to £68 17s. 6d.; Wednesday, £68 15s. to £68 17s. 6d.

Tin.—After fluctuating to lower levels during the past week, values of standard tin recovered sharply towards the close, and prospects, from the point of view of the producer, are encouraging. It is considered probable that 1930 will witness an increased European consumption. During the last three years there has been a steady increase in the amount of tin consumed in countries other than the United Kingdom and the United States, and this expansion in demand, coupled with the success of the Tin Producers' Association's restriction of output scheme, makes the outlook decidedly more promising.

Official closing prices :—

Cash.—Thursday, £174 15s. to £175; Friday, £173 12s. 6d. to 173 15s.; Monday, £172 to £172 2s. 6d.; Tuesday, £170 10s. to £170 12s. 6d.; Wednesday, £171 5s. to £171 7s. 6d.

Three Months. — Thursday, £177 15s. to £177 17s. 6d.; Friday, £176 10s. to £176 12s. 6d.; Monday, £175 to £175 2s. 6d.; Tuesday, £173 10s. to £173 12s. 6d.; Wednesday, £173 17s. 6d. to £174.

Spelter.—The position in the market for ordinary spelter remains without change, and business generally is dull and depressed. European stocks are extremely heavy, and quotations are unsteady, with a tendency to fall. The demand remains noticeable by its absence, and the outlook is not promising.

Daily quotations are :—

Ordinary.—Thursday, £18 17s. 6d.; Friday, £18 16s. 3d.; Monday, £19; Tuesday, £18 15s.; Wednesday, £18 6s. 3d.

Lead.—It is difficult to comment on the movements of the lead market, because it is so strongly controlled. For some time dealings have been on a restricted scale, and last week's turnover was very low indeed. There is practically no competitive selling, and fluctuations in price are very small.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £20 13s. 9d.; Friday, £21 3s. 9d.; Monday, £21 2s. 6d.; Tuesday, £20 3s. 9d.; Wednesday, £20 3s. 9d.

Students' Corner.

Q.—What are chills? Are they made from the same materials as denseners?

A.—Chills have a function of their own apart from denseners, as we have seen a densener is to equalise liquid cooling. A chill has quite a legitimate use in hardening and densening certain parts of castings for various uses; such as hard surface rolls (as the opposite to grain rolls), stone crushers, Surfaces which require to be hard and almost white, such as tile shoes, metal breakers, and many other castings to withstand very hard wear. Chills are mostly made from the same materials as denseners.

Q.—Are there any special precautions that should be taken with chills?

A.—The precautions that are taken with denseners must be taken with chills.

Q.—What change takes place in the iron when it is white chilled?

A.—The carbon in the white chilled iron remains combined, *i.e.*, the carbon, or part of it, that should naturally be in the graphite form (free) remains in solution, in other words the carbon is dissolved in the iron, hence its hardness and whiteness.

CAST IRON FLANGED PIPES
2 in.–12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone: 52 & 53. MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

BLACKING,
PLUMBAGO,
CORE GUM,
WHITE DUST,
COAL DUST.

ESTABLISHED 1863.

JAS. DURRANS & SONS, LTD.
PHŒNIX WORKS, PENISTONE, near SHEFFIELD.

Telephone:
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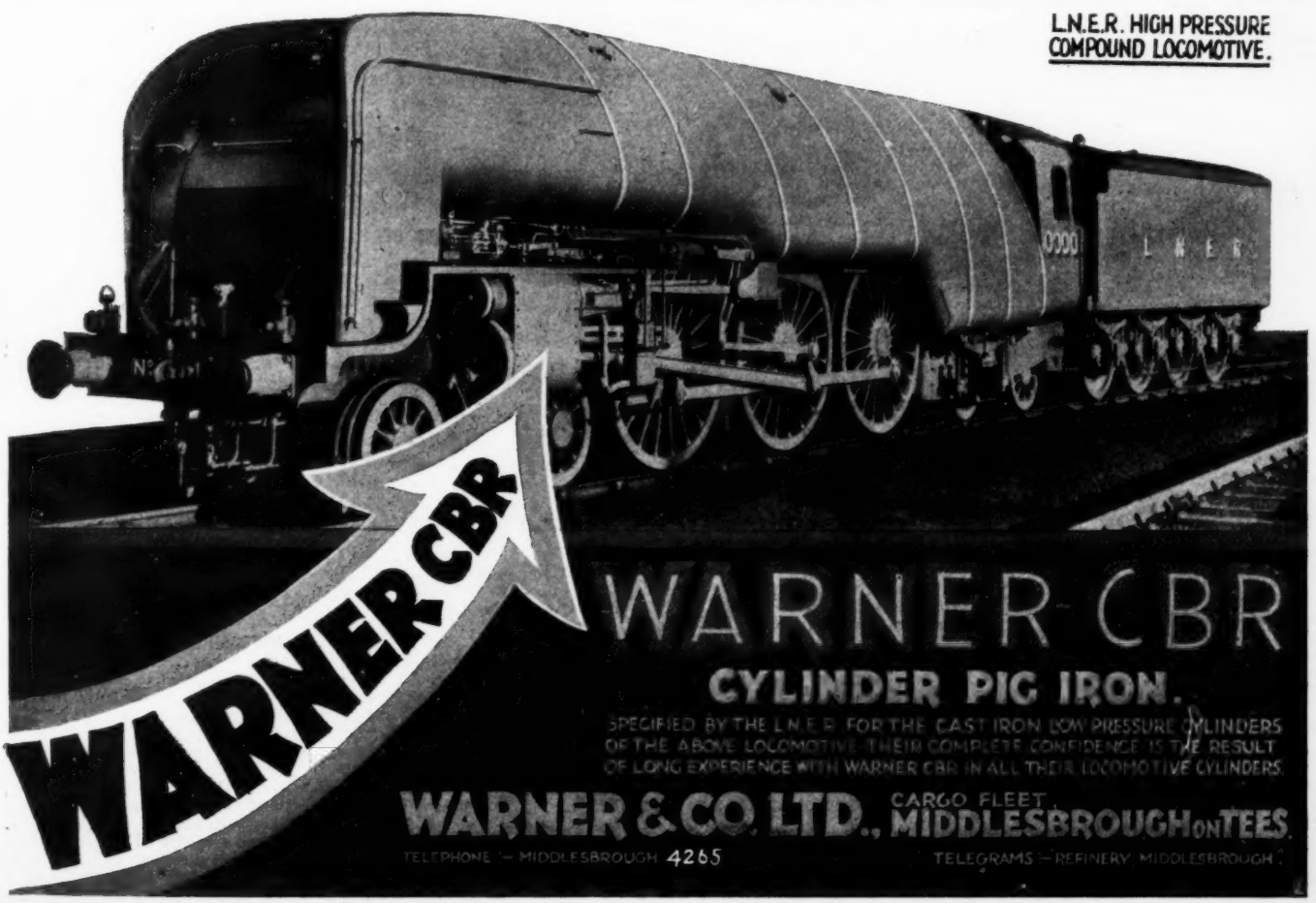
FOUNDRY EQUIPMENTS

LADLES,
FIRE BRICKS,
STONE FLUX,
CASTING CLEANERS,
PIPE NAILS,
SPRIGS,
WIRE BRUSHES,
BELLOWS,
CUPOLAS,
GANISTER,
LOAM AND SAND MILLS,
STUDS,
CHAPLETS,
BRUSHES,
CORE ROPES,
BUCKETS,
SPADES, Etc.

Write for Illustrated Catalogue on Blacking and Foundry Requisites.

L.N.E.R. HIGH PRESSURE COMPOUND LOCOMOTIVE.



WARNER CBR
CYLINDER PIG IRON.
SPECIFIED BY THE L.N.E.R. FOR THE CAST IRON LOW PRESSURE CYLINDERS OF THE ABOVE LOCOMOTIVE. THEIR COMPLETE CONFIDENCE IS THE RESULT OF LONG EXPERIENCE WITH WARNER CBR IN ALL THEIR LOCOMOTIVE CYLINDERS.
WARNER & CO. LTD., CARGO FLEET, MIDDLESBROUGH ON TEES.
TELEPHONE — MIDDLESBROUGH 4265
TELEGRAMS — REFINERY, MIDDLESBROUGH.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	69	10	0
Three months	68	15	0
Electrolytic	83	10	0
Tough	76	15	0
Best selected	77	5	0
Sheets	110	0	0
India	89	10	0
Wire bars	84	5	0
Do. Feb.	84	5	0
Do. March.	84	5	0
Ingot bars	84	5	0
H.C. wire rods	86	5	0
Off. av. cash, January	71	11	1 13/14
Do., 3 mths., January	69	0	2 1/2
Do., Sttlmnt., January	71	10	8 5/11
Do., Electro, January	83	10	9 61/11
Do., B.S., January	77	3	7 1/2
Do., wire bars, January	83	16	7 1/11
Aver. spot price, copper, Jan.	71	11	1 13/14
Solid drawn tubes			15d.
Brazed tubes			15d.
Wire			11½d.

BRASS.

Solid drawn tubes	12½d.
Brazed tubes	14½d.
Rods, drawn	12½d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g.	11½d.
Wire	10½d.
Rolled metal	10½d.
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£	s.	d.
Standard cash	171	5	0
Three months	173	17	6
English	172	5	0
Bars	173	10	0
Straits	172	17	6
Australian	171	15	0
Eastern	176	10	0
Banca	174	10	0
Off. av. cash, January	175	10	10 10/11
Do., 3 mths, January	178	15	2 5/11
Do., Sttlmt., January	175	10	5 5/11
Aver. spot, January	175	10	10 10/11

SPELTER.

	£	s.	d.
Ordinary	18	6	3
Remelted	17	15	0
Hard	15	15	0
Electro 99.9	21	5	0
English	19	7	6
India	16	15	0
Zinc dust (Nom.)	27	0	0
Zinc ashes	5	10	0
Off. aver., January	19	18	9
Aver., spot, January	19	12	8 1/22

LEAD.

	£	s.	d.
Soft foreign ppt.	20	3	9
English	21	15	0
Off. average, January	21	11	1 13/44
Average spot, January	21	10	10 10/11

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	28	0	0
Do. V.M. ex-whf.	27	0	0
Rods	32	10	0
Boiler plates	25	10	0
Battery plates	26	0	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	42	10	0
Chinese	29	10	0
Crude	17	10	0

QUICKSILVER.

	£	s.	d.
Quicksilver	23	0	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
25%	7	17	6
45/50%	11	10	0
75%	19	0	0
Ferro-vanadium—			
35/50%	12/9 lb. Va.		
Ferro-molybdenum—			
70/75% c. free	4/2 lb. Mo.		
Ferro-titanium—			
23/25% carbonless	9d. lb.		
Ferro-phosphorus, 20/25%	£16	0	0
Ferro-tungsten—			
80/85%, c. fr.	3/1½ lb.		
Tungsten metal powder—			
98/99%	3/4½ lb.		
Ferro-chrome—			
2/4% car.	£30	0	0
4/6% car.	£23	5	0
6/8% car.	£22	7	6
8/10% car.	£22	2	6
Ferro-chrome—			
Max. 2% car.	£33	10	0
Max. 1% car.	£38	0	0
Max. 0.70% car.	£40	5	0
70%, carbonless	11d. lb.		
Nickel—99% cubes, or pellets	£175	0	0
Ferro-cobalt	9/6 lb.		
Aluminium 98/99%	£95	0	0
Metallic chromium—			
96/98%	2/7 lb.		
Ferro-manganese (net)—			
76/80% loose	£12	10	0
76/80% packed	£13	10	0
76/80%, export	£12	15	0
Metallic manganese—			
94/96%, carbonless	1/4 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	£	s.	d.
Finished bars, 14% tungsten	£0	2	0
Finished bars, 18% tungsten	£0	2	9

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/32 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel	3	6	6	to	3	7	6
Bundled steel and shrngs.	3	1	0	to	3	5	0
Mixed iron and steel	3	0	0	to	3	2	6
Heavy cast iron	2	18	0	to	2	19	0
Good machinery for foundries	3	0	0	to	3	2	6
Cleveland—							
Heavy steel					3	2	6
Steel turnings					2	13	0
Cast-iron borings					2	12	0
Heavy forge					4	0	0
W.I. piling scrap					3	12	6
Cast-iron scrap	3	2	6	to	3	5	0
Midlands—							
Ord. cast-iron scrap					3	5	0
Heavy wrought					4	0	0
Steel turnings					2	2	6
Scotland—							
Heavy steel					3	5	6
Cast-iron borings					2	10	0
Wrought-iron piling					3	19	0
Heavy machinery					3	10	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	61	0	0
Brass	43	0	0
Lead (less usual draft)	20	0	0
Tea lead	16	0	0
Zinc	13	0	0
New aluminium cuttings	65	0	0
Braziery copper	57	0	0
Gunmetal	54	0	0
Hollow pewter	130	0	0
Shaped black pewter	97	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	75/-
Foundry No. 3	72/6
Foundry No. 4	71/6
Forge No. 4	71/-
Hematite No. 1	78/6
Hematite M/Nos.	78/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	87/-
,, d/d Birm.	95/6
Midlands—	
Staffs. common*	—
,, No. 4 forge*	74/6
,, No. 3 fdry.*	78/6
Shrops. basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	71/-
,, fdry. No. 3*	75/-
Derbyshire forge*	74/6
,, fdry. No. 3*	78/6
,, basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	80/6
,, No. 3	78/-
Hem. M/Nos.	81/-
Sheffield (d/d district)—	
Derby forge	69/6
,, fdry. No. 3	73/6
Lincs. forge.	71/6
,, fdry No. 3	75/6
E.C. hematite	89/-
W.C. hematite	91/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	77/-
Northants foundry No. 3	—
Dalzell, No. 3 (special)	105/- to 107/6
Summerlee, No. 3	95/-
Glengarnock, No. 3	—
Gartsherrie, No. 3	95/-
Monkland, No. 3	95/-
Shotts, No. 3	95/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron ; delivered consumers' station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.) nom.					10	15	0
Nut and bolt iron	9	2	6	to	9	7	6
Hoops	10	15	0	to	11	5	0
Marked bars (Staffs) f.o.t.					12	10	0
Gas strip	10	15	0	to	11	5	0
Bolts and nuts, ¾ in. × 4 in.	15	5	0				
Steel—							
Ship plates	8	15	0	to	8	17	6
Boiler plts.	9	17	6	to	10	10	0
Chequer plts.					10	12	6
Angles					8	7	6
Tees					9	7	6
Joists					8	10	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ¾ in. (Untested)					8	2	6
					and upwards		
Flats—8 in. wide and over					8	12	6
,, under 8 in. and over 5 in.					8	17	6
Rails, heavy					8	10	0
Fishplates					12	0	0
Hoops (Staffs)	9	10	0	to	9	15	0
Black sheets, 24g.					9	15	0
Galv.cor.shts., 24g.	11	10	0	to	11	15	0
Galv. fencing wire, 8g. plain					12	0	0
Billets, soft	6	2	6	to	6	12	6
Billets, hard	7	10	0	to	8	0	0
Sheet bars	5	17	6	to	6	5	0
Tin bars	5	17	6	to	6	5	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/4
Sheet to 10 w.g.	1/5
Wire	1/6
Rods	1/5
Tubes	1/9½
Castings	1/4

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	10d. to 1/4
Rolled—	
To 9 in. wide	1/4 to 1/10
To 12 in. wide	1/4½ to 1/10½
To 15 in. wide	1/4½ to 1/10½
To 18 in. wide	1/5 to 1/11
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6 to 2/-
Ingots for spoons and forks	10d. to 1/6½
Ingots rolled to spoon size	1/1 to 1/9½
Wire round—	
3/0 to 10 G.	1/7½ to 2/2½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	20 76
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.50
Basic	20.26
Bessemer	20.76
Malleable	20.76
Grey forge	19.76
Ferro-mang. 80% d/d	94.00
O.-h. rails, h'y, at mill	43.00
Bessemer billets	33.00
O.-h. billets	35.00
O.-h. sheet bars	33.00
Wire rods	40.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.85
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.85
Skelp, sheared steel	1.85
Steel hoops	2.20
Sheets, black, No. 24	2.60
Sheets, galv., No. 24	3.30
Sheets, blue an'l'd, No. 13	2.25
Wire nails	2.25
Plain wire	2.40
Barbed wire, galv.	2.95
Tinplates, 100-lb. box	$5.25

COKE (at ovens).

Welsh foundry	27/6 to 30/-
,, furnace	22/6 to 25/-
Durham and Northumberland—	
,, foundry	16/6 to 17/6
,, furnace	18/6
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box		18/6
,,	28×20 ,,		37/-
,,	20×10 ,,		26/6
,,	18¾×14 ,,		19/3
C.W.	20×14 ,,		16/-
,,	28×20 ,,		34/3
	20×10 ,,		23/6
,,	18¾×14 ,,		17/-
Terneplates	28×20		32/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to	£7	10	0
Bars, hammered, basis	£17	10	0	to	£18	10	0
Bars and nail-rods, rolled, basis	£15	17	6	to	£16	15	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£32	0	0	to	£33	0	0
Faggot steel	£20	0	0	to	£24	0	0
Bars and rods dead soft, steel	£11	0	0	to	£14	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ⅛ in. up to 6 in.

	Tubes.	*Fittings.*
Gas ..	.. 65% ..	.. 47½%
Water ..	.. 61½% ..	.. 42½%
Steam ..	.. 57½% ..	.. 37½%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Feb.	20 ..	69	17	6	dec.	2/6
,,	21 ..	69	15	0	,,	2/6
,,	24 ..	69	10	0	,,	5/–
,,	25 ..	69	5	0	,,	5/–
,,	26 ..	69	10	0	inc.	5/–

Electrolytic Copper.

		£	s.	d.			
Feb.	20 ..	83	10	0	No	change	
,,	21 ..	83	10	0	,,	,,	,,
,,	24 ..	83	10	0	,,	,,	,,
,,	25 ..	83	10	0	,,	,,	,,
,,	26 ..	83	10	0	,,	,,	,,

Standard Tin (cash).

		£	s.	d.		
Feb.	20 ..	174	15	0	inc.	10/–
,,	21 ..	173	12	6	dec.	22/6
,,	24 ..	172	0	0	,,	32/6
,,	25 ..	170	10	0	,,	30/–
,,	26 ..	171	5	0	inc.	15/–

Tin (English ingots).

		£	s.	d.			
Feb.	20 ..	175	15	0	inc.	10/–	
,,	21 ..	174	12	6	dec.	22/6	,,
,,	24 ..	173	0	0	,,	32/6	,,
,,	25 ..	171	10	0	,,	30/–	,,
,,	26 ..	172	5	0	inc.	15/–	,,

Zinc Sheets (English).

		£	s.	d.			
Feb.	20 ..	28	0	0	dec.	20/–	
,,	21 ..	28	0	0	No	change	
,,	24 ..	28	0	0	,,	,,	,,
,,	25 ..	28	0	0	,,	,,	,,
,,	26 ..	28	0	0	,,	,,	,,

Spelter (ordinary).

		£	s.	d.		
Feb.	20 ..	18	17	6	inc.	1/3
,,	21 ..	18	16	3	dec.	1/3
,,	24 ..	19	0	0	inc.	3/9
,,	25 ..	18	15	0	dec.	5/–
,,	26 ..	18	6	3	,,	8/9

Lead (English).

		£	s.	d.		
Feb.	20 ..	22	5	0	dec.	10/–
,,	21 ..	22	10	0	inc.	5/–
,,	24 ..	22	10	0	No	change
,,	25 ..	21	15	0	dec.	15/–
,,	26 ..	21	15	0	No	change

AVERAGE PRICES OF GALVANISED CORRUGATED SHEETS (NORTH OF ENGLAND).

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1901	13 0 0	12 5 0	11 10 0	11 16 0	11 10 0	11 10 0	11 10 0	11 10 0	12 0 0	12 0 0	12 0 0	12 0 0	11 17 1
1902	12 0 0	11 10 0	11 10 0	11 10 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 15 0	11 14 2
1903	11 5 0	11 5 0	11 5 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 7 1
1904	11 5 0	11 5 0	11 5 0	11 5 0	10 15 0	10 15 0	10 15 0	10 15 0	10 5 0	10 5 0	10 5 0	10 5 0	10 15 0
1905	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	11 0 0	11 5 0	11 15 0	12 0 0	10 15 0
1906	12 12 6	12 12 6	12 12 6	12 7 6	12 7 6	12 7 6	12 12 6	12 12 6	12 15 0	12 15 0	12 15 0	13 5 0	12 12 11½
1907	13 5 0	13 5 0	13 15 0	13 15 0	13 15 0	13 15 0	13 17 6	13 17 6	13 17 6	13 2 6	13 2 6	13 2 6	13 10 10
1908	13 2 6	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 11 0½
1909	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 16 8
1910	11 15 0	12 5 0	12 5 0	11 15 0	11 10 0	11 10 0	11 12 6	11 12 6	11 12 6	11 12 6	11 10 0	11 10 0	11 13 4
1911	11 5 0	11 1 3	10 15 0	10 15 0	10 13 9	10 10 0	10 13 9	11 0 0	11 5 0	11 5 0	11 5 0	11 7 0	10 18 7½
1912	11 10 0	11 10 0	11 10 0	11 15 0	12 5 0	12 5 0	12 5 0	12 5 0	12 5 0	12 12 6	12 18 0	12 15 0	12 2 11½
1913	12 15 0	12 15 0	12 15 0	12 11 3	11 18 0	11 15 0	11 15 0	11 15 0	11 15 0	11 3 0	11 0 0	11 2 6	11 18 4
1914	11 7 0	11 7 6	11 7 6	11 5 7½	11 2 6	10 15 0	10 15 0	12 17 6	14 2 0	13 7 0	11 15 7	11 2 6	11 16 0
1915	11 10 8½	13 12 6	14 8 9	15 0 6	17 17 6	20 17 6	20 17 6	20 6 3	17 12 6	18 1 0	22 13 9	25 2 0	18 3 4½
1916	26 5 0	27 12 6	28 0 0	28 5 0	29 0 0	29 0 0	28 15 0	28 3 0	28 15 0	28 15 0	28 15 0	28 15 0	28 6 8½
1917	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 15 0	28 0 0	28 0 0	28 0 0	28 11 3
1918	28 5 0	28 15 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	29 0 0	28 13 4
1919	29 0 0	29 0 0	29 0 0	28 0 0	28 10 0	27 7 6	27 5 0	29 3 0	32 0 0	33 0 0	36 10 0	40 8 4	31 5 3½
1920	46 10 0	49 15 0	53 15 0	56 0 0	55 10 0	54 10 0	52 10 0	48 10 0	44 3 4	39 2 6	35 17 6	30 8 0	47 4 3
1921	28 10 0	25 17 6	24 5 0	23 3 4	22 0 0	22 0 0	23 10 0	21 12 6	20 0 0	18 15 0	18 3 9	17 2 0	22 1 7
1922	16 17 6	15 13 9	16 3 0	16 10 0	16 4 4½	15 15 6	15 16 3	16 16 0	16 8 9	16 6 3	17 1 0	17 7 6	16 7 5½
1923	18 3 1½	19 1 11½	19 8 0	19 7 0	19 1 3	18 0 0	18 13 1½	19 0 0	19 3 9	19 2 6	18 19 4½	18 19 2	
1924	18 13 6	18 9 4½	18 5 0	17 15 11½	17 3 0	17 19 4½	18 7 6	18 8 1½	18 8 1½	17 19 6	17 11 3	17 10 0	18 0 10½
1925	17 8 6	17 1 6½	16 9 4½	16 12 0	16 9 8½	16 0 6	16 1 10½	16 5 0	16 7 0	16 12 6	6 15 0	16 11 0½	
1926	16 14 4½	16 5 7½	16 0 6	15 11 10½	15 11 3	16 0 0	16 16 0	16 18 9	16 14 0	16 18 9	17 10 0	6 19 0	16 10 0½
1927	16 3 1	15 7 6	15 3 3	15 3 1½	14 14 4½	14 11 6	14 1 10½	14 0 0	13 19 6	13 16 10½	13 13 1½	13 3 9	14 9 10
1928	13 0 0½	13 2 6	13 6 0	13 2 6	13 3 0	13 6 9	13 11 3	13 10 0	13 10 7½	13 12 6	13 11 6	13 10 0	13 8 8½
1929	13 11 0	13 13 1½	13 12 9½	13 10 11½	13 9 3	13 8 9	13 11 6	13 7 6	13 7 6	13 5 6	12 18 9	12 12 9½	13 7 5½
1930	12 5 0	—	—	—	—	—	—	—	—	—	—	—	—

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